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EGROT'S SMALL DISTILLING APPARATUS.

The apparatus for distillatory purposes, manufactured by M. Egrot, are so well known that it is unnecessary to describe them in detail, and we shall therefore confine ourselves to a brief description of one of the smaller sizes and one of the portable styles that the inventor has recently introduced.

1. *Egrot's Small Stationary Still.*—(Fig. 1.)—This apparatus, which is constructed on the same principle as the larger ones of the same inventor, possesses the same advantages, the chief of these being the peculiar mode of construction of the condensing boxes, which offer a very wide operating surface. These boxes are divided by concentric circular disks in such a way as to give the liquid a considerable distance to travel, during which it becomes completely divested of the alcohol that it contains. Such action is still further increased by the presence of small tubes which divide the ascending vapors over the whole surface of the boxes and produce ebullition that hastens the distillation. Fig. 1, which gives a general view of one of these apparatus, will be understood from the following description:

A, condensing boxes; B, cover of the latter; C, rectifying column; E, swan neck; F, wine-heating condenser; K, pipe for leading the wine from the wine-heater to the condensing boxes; N, re-entrance of the back flow into the rectifying column; R, regulating reservoir; S, float cock; T, cock with division plate for regulating the flow of wine into the apparatus; V, test glass; Y, tinned copper graduated vessel for the reception of the products on issuing from the test glass; *a*, alembic; *b*, siphon; *c*, blow-off cock; *d*, level indicator; *e*, screw plug to allow of cleaning the lower part; *x*, boiler plate furnace lined with fire-brick.

The operation of the apparatus is as follows:

After putting the cock, S, in communication with the reservoir containing the wine to be distilled, the cock, T, is opened. The liquid then flows into the funnel, J, which communicates with the wine heater, F, fills it, and overflows through the pipe, K, into the condensing boxes, A, each of which retains a portion. The alembic is afterward filled, and a fire is lighted in the furnace. The contents of the alembic, *a*, soon enter into ebullition, and, before long, the alcohol makes its appearance in the test glass, V, where its degree is tested by the aid of an alcoholmeter. Finally, the cock, T, is regulated in such a way that the flow may take place in the proportion desired.

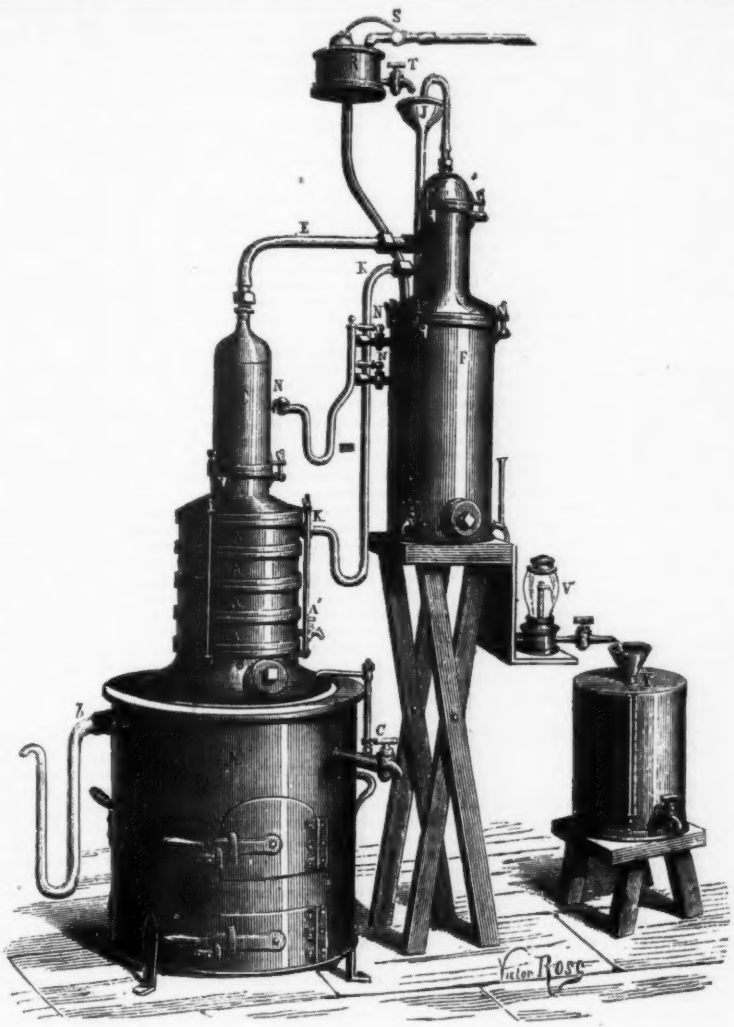


Fig. 1.—EGROT'S STATIONARY STILL.

These small apparatus are easily set up, and are readily carried from one place to another. They require but little fuel, and are capable of producing brandies of from 50° to 70°, or spirits of from 75° to 90°.

2. *Egrot's Portable Still.*—For the purpose of rendering his apparatus very portable, Mr. Egrot has constructed one on the same system, carried on two wheels with springs.

By reason of the limited height that this apparatus had to be given, the parts (which are identical with those of the stationary still) have had to be arranged in an entirely different manner, as may be seen by reference to Fig. 2, and the following description:

A, condensing boxes; D E, exit for alcoholic vapors flowing to the tubular rectifier; F, tubular rectifier; G, spiral condenser mounted in a copper tank; H, movable smoke-stack; K, pipe for leading the wine from the condenser to the rectifier; K^1, pipe for leading into the distilling column the wine that has already traversed the condenser and rectifier; L, pipe for leading the uncondensed vapors into the rectifier; N, back flow for the waters that re-enter the condensing boxes; V, outlet for the alcohol; X, a small pump actuated by a wooden handle and designed for forcing wine into the tank, Z; Z, plate iron tank into which the wine to be distilled is forced, and from whence it flows continuously through the funnel, J, into the wine-heater; *a*, alembic; *b*, siphon tube through which flow the residues from distillation.

This apparatus is capable of yielding, on first distillation, brandies of from 50° to 70°, or spirits of 85°.

The whole apparatus may be drawn by a single horse.—*Annales Industrielles.*

AMERICAN BEER GLASSES IN GERMANY.—In a recent communication from United States Vice-Consul Wm. Hummel, at Munich, the surprising fact is noted that a large proportion of the five millions of beer glasses used annually in Berlin are imported from America. Mr. Hummel thinks that it would be a good plan for American makers to establish agencies in other German cities, and expresses a willingness to forward, so far as he can, any efforts in that direction.

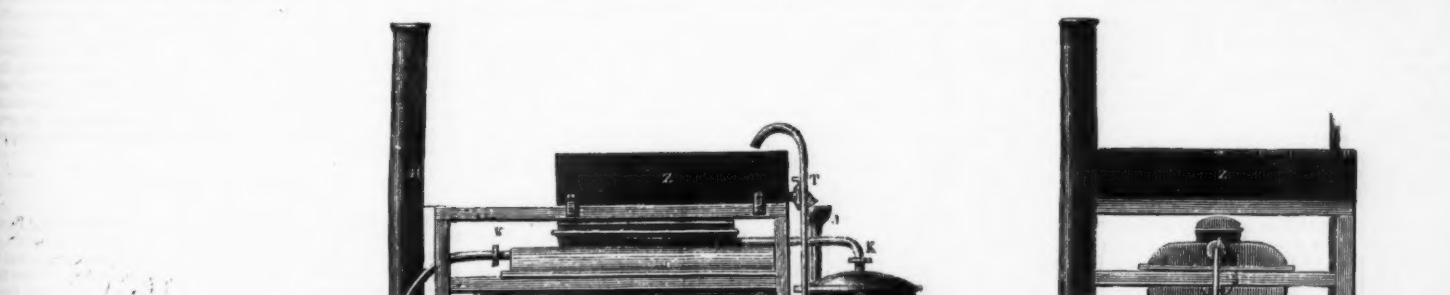


Fig. 2.—EGROT'S PORTABLE STILL.

ROADS, TUNNELS, BRIDGES, AND CANALS.*

GENTLEMEN: Of all the important sections of the British Association, the one over which I have now the honor of presiding is, you will all, I think, admit, at once the most practical and the most characteristic of the age. In future times the present age will be remembered chiefly for the vast strides which have been made in the advancement of mechanical science. Other days have produced as great mathematicians, chemists, physicists, warriors, and poets, but no other age has made such demands upon the professors of mechanical science, or has given birth to so many men of eminence in that department of knowledge. Though a member of the profession myself, I may venture before my present audience to claim that the civil engineer is essentially a product and a type of the latest development of the present century. Telford has admirably defined the profession of a civil engineer as "being the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns." This definition, written more than half a century ago, is wide enough to include all branches of engineering of the present day, although among those specifically mentioned the departments presided over by the railway engineer, the locomotive superintendent, and the electrician will be looked for in vain. As Telford was beyond all question the most widely experienced and far seeing engineer of his time, this little omission well illustrates and justifies my statement that the typical civil engineer of the day is a late product of the present century; for even Telford never foresaw the vast changes which railways, steam, and electricity would evolve in the course of a few years.

RAILWAY ENGINEERING.

There have undoubtedly been published during the last fifty years many works of mark and merit, but the work which above all others would, I think, have astonished and perplexed our ancestors, is the little one known to all the civilized world as "Bradshaw." This indispensable handbook of the nineteenth century testifies that the face of the country is dotted over literally with thousands of railway stations; that between many of these stations trains run at two-minute intervals, while the distance between others is traversed at a mean speed of nearly 60 miles an hour. The public are often justly indignant at the want of punctuality on some railways, but they should blame the management and not the engineers, for the daily conduct of the heavy traffic between England and Scotland shows that, notwithstanding the constantly varying condition of wind and weather in this climate, a run of 400 miles can, on a properly laid out railway, and with suitably designed rolling stock, be accomplished with certainty to the minute, if the management is not at fault.

On the Great Northern Railway, for instance, of which I am consulting engineer, the 400 miles between London and Edinburgh is traversed in nine hours, or, deducting the half-hour allowed at York for dining, at the mean rate of no less than 47 miles per hour, including stoppages.

A few months ago the Duke of Edinburgh was taken on the same line of railway from Leeds to London, a distance of 186¾ miles, in exactly three hours, or at a mean rate, including a stop at Grantham, of over 62 miles an hour.

I know of no railway in the world where this performance has been eclipsed, and it will be, perhaps, both instructive and amusing to contrast with it the performance of the engines at the opening ceremony of the Liverpool and Manchester Railway, on September 15, 1830. A newspaper correspondent of the time, after describing many eventful incidents of his journey, proceeds as follows: "The twenty-four vehicles left behind were now formed into one continuous line, with the three remaining engines at their head, and at twenty minutes past five o'clock we set out on our return to Liverpool. The engines not having the power, however, to drag along the double load that had devolved upon them at a faster rate than from five to ten miles an hour—once or twice only, and that but for a few minutes, did it reach the rate of twelve miles—it was past eight o'clock before we reached Parkside. Proceeding onward, we were met on the Kenyon Embankment by two of the missing engines, which were immediately attached to the three which had drawn us from Manchester. We went still slower than before, stopping continually to take in water—query, to take breath—and creeping along at a snail's pace till we reached Sutton inclined plane, to get up which the greater part of the company were under the necessity of alighting and making use of their own legs. On reaching the top of the plane we once more took our seats, and at ten o'clock we found ourselves again at the company's station in Crown street, having accomplished the distance of thirty-three miles in four hours and forty minutes." The incident of the passengers descending from a train headed by five engines to walk up an insignificant incline is, I think, worthy of being recalled to the remembrance of the traveling public who are accustomed to see without astonishment a single engine rushing along with a train of a dozen heavy carriages at as high a speed as if it were running alone.

We must do our immediate forefathers, however, the justice to remember that even they effected some considerable improvements in the speed of locomotion. For example, in 1763 the only public conveyance for passengers between London and Edinburgh was a single coach, which completed its journey in fourteen days, or at the average rate of 1¼ miles per hour. Strange as it may appear, there are at the present time many large fertile districts in Hungary where, owing to the absence both of road and water communications, a higher rate of speed cannot be attained in a journey of several days' duration. An essential condition of the attainment of high speed on the railway is that the stopping places be few and far between.

The Great Northern express, previously referred to, makes its first halt at Grantham, a distance of 105 miles from London, and consequently but little power and time are lost in accelerating and retarding the speed of the train. In the instance of the Metropolitan Railway, on the other hand, the stations average but half a mile apart, and although the engines are as powerful as those on the Great Northern Railway, while the trains are far lighter, the average speed attainable is only some twelve miles an hour. No sooner has a train acquired a reasonable speed than the brakes have to be sharply applied to pull it up again. As a result of experiment and calculation, I have found that 60 per cent. of the whole power exerted by the engines is absorbed by the brakes. In other words, with a consumption of 30 lb. of coal per train mile, no less than 18 lb. are expended in grinding away the brake blocks, and only the remaining 12 lb. in doing the useful work of overcoming frictional and atmospheric resistances.

Comparatively high speed and economy of working might be attained on a railway with stations at half-mile intervals if it were possible to arrange the gradients so that each station should be on the summit of a hill. An ideal railway would have gradients of about 1 in 20 falling each way from the stations, with a piece of horizontal connecting them. With such gradients gravity alone would give an accelerating velocity to the departing train at the rate of one mile per hour for every second; that is to say, in half a minute the train would have acquired a velocity of 30 miles an hour, while the speed of the approaching train would be correspondingly retarded without the grinding away of brake blocks. Could such an undulating railway be carried out, the consumption of fuel would probably not exceed one-half of that on a dead level railway, while the mean speed would be one-half greater. Although the required conditions are seldom attainable in practice, the broad principles should be kept in view by every engineer when laying out a railway with numerous stopping places.

Nearly thirty years ago, when projecting the present system of underground railways in the metropolis, I foresaw the inconveniences which would necessarily result from the use of an ordinary locomotive, emitting gases in an imperfectly ventilated tunnel, and proposed to guard against them by using a special form of locomotive. When before the parliamentary committee in 1854, I stated that I should dispense with firing altogether, and obtain the supply of steam necessary for the performance of the single trip between Paddington and the City from a plain cylindrical egg-ended boiler, which was to be charged at each end of the line with water and steam at a high pressure. In an experimental boiler constructed for me, the loss of pressure from radiation proved to be only 30 pounds per square inch in five hours, so that practically all the power stored up would be available for useful work. I also found by experiment that an ordinary locomotive with the fire "dropped" would run the whole length of my railway with a train of the required weight. Owing to a variety of circumstances, however, this hot water locomotive was not introduced on the Metropolitan Railway, though it has since been successfully used on tramways at New Orleans, Paris, and elsewhere.

I am sorry to have to admit that the progress of mechanical science, so far as it affects locomotives for underground railways, has been absolutely *nil* during the past thirty years. The locomotive at present employed is an ordinary locomotive, worked in the ordinary way, except that in the tunnel the steam is condensed, and combustion is aided by the natural draught of the chimney alone, instead of being urged by a forced blast as on open portions of the line. Whether a hot water, a compressed air, or a compressed gas locomotive could be contrived to meet the exigencies of metropolitan traffic is a question which, I think, might be usefully discussed at the present or at some future meeting of the Association. A reference to the underground railway naturally suggests the wider question of tunnels in general.

TUNNEL ENGINEERING.

The construction of tunnels was not one of the novelties presenting itself to railway engineers, for many miles of tunnel had been driven by canal engineers before a single mile of passenger railway had been built in this or any other country. To foreign engineers belongs the honor of having boldly conceived and ably accomplished tunnel works of a magnitude which would have appalled a canal engineer. I need only to refer to the Mont Cenis Tunnel, over 7½ miles in length, commenced in 1857 and finished in 1870; the St. Gothard Tunnel, 9¼ miles in length, commenced in 1872 and finished in 1882; and the Hoosac Tunnel, 4¾ miles in length, commenced in 1854 and finished in 1875. In all cases rock of the hardest character had to be pierced, and it is needless to remark that without the aid of the machinist in devising and manufacturing compressed air machinery and rock boring plant the railway engineer could not have accomplished his task. Intermediate shafts are not attainable in tunnels driven through great mountain ranges, so all the work has to be done at two faces.

In the case of the Mont Cenis Tunnel the mean rate of progress was 257 feet and the maximum, 400 feet per month. In the St. Gothard Tunnel the mean rate was 429 feet and the maximum 810 feet. In the Hoosac Tunnel the average rate was 150 feet per month. Tunnels under broad, navigable rivers and estuaries have been a subject of discussion by engineers for at least a century, but the only one at present completed is the unfortunate and costly Thames Tunnel.

Two important works of the class are, however, now well in hand, namely, the Severn Tunnel at Portskewet, and the Mersey Tunnel at Liverpool. Undoubtedly the numerous accidents which occurred during the construction of the Thames Tunnel, together with its enormous cost of about £1,500 per lineal yard, and the eighteen years occupied in its construction, destroyed the chance of any other projected subaqueous tunnel for many subsequent years. One lesson enforced by the Thames Tunnel was the necessity of leaving a reasonable thickness of ground between the water and the tunnel. In the Severn Tunnel the minimum thickness is 40 feet, and in the Mersey Tunnel, 22 feet. The width of river at the point of crossing of the former tunnel is two and a quarter miles, and the maximum depth of the rails below high water 163 feet. In the case of the Mersey Tunnel the width is nearly three-quarters of a mile, and the depth 144 feet. The Thames Tunnel, as almost every one knows, was carried on by means of a special contrivance termed by Brunel a "shield." No special appliances have been adopted in the case either of the Severn or the Mersey Tunnel. Both are driven in the ordinary way, but of course enormous pumping power is required and has been provided. In many cases of tunnels under estuaries, special appliances could be used which would obviate all risk and make the successful completion of the work a mathematical certainty.

A tunnel under the Humber, about one and a half miles in length, projected by myself in 1873, the bill for which was subsequently passed by the Commons and thrown out by the Lords, was a case in point. The bed of the Humber is of very fine silt, and I proposed to build the tunnel in lengths of 160 feet, under the protection of rectangular iron caissons 160 feet long by 42 feet wide, sunk by the pneumatic process. As the pressure of the air in the caissons would always be slightly in excess of that due to the head of water in the river, no interruption from influx of water could ever occur, and the operation of building the tunnel in lengths inside this huge diving-bell would be as certain and free from risk as the every-day work of sinking a bridge pier by the pneumatic process.

A tunnel over a mile in length now in progress under the Hudson River at New York is being driven through a silty stratum by the aid of compressed air, and with a certain amount of success, as only some twenty men have been drowned up to the present time. The principle upon which the compressed air is used is, however, a false one, since it is merely forced into the tunnel with a view to uphold the ground by its pressure, like so much timbering, and not to keep out the water on the principle of a diving bell. It is clear, therefore, that the completion of the Hudson River Tunnel, if the present system be persevered in, is purely a matter of conjecture, and all we can do is to hope for the best. That the series of mishaps with the Thames Tunnel, and the consequent postponement of all other projects for subaqueous tunnels, were due to errors in design and want of foresight on the part of the engineer, is patent to every one now, and was foreseen by at least one acute contemporary of Brunel himself.

Only a few months ago, when turning over the leaves of an old periodical, I became aware of the fact that a scheme, identical in all its main features with my Humber Tunnel project, had been suggested for adoption in the case of the Thames Tunnel, in lieu of the plan proposed by Brunel. Writing in December, 1823, or fifty-nine years ago, the author of the project a working smith of the name of Johnson, says: "I propose to construct the Thames Tunnel without cofferdams by making it in parts, 28 feet in length, each part having the ends temporarily stopped up and being constructed on the same principle as the diving-bell. The men dig from the inside round the edge as if sinking a well, and throw the earth toward a dredger, the buckets of which work some feet below the bottom of the excavation. Each length will be suspended between two vessels and be conveyed to the place where it is to be let down." A description of the mode of connecting the several lengths is given, and I may add that the tunnel blocks had a sloping face to tend to bring the faces of the joints together, a plan since adopted with the huge concrete blocks at Kurrachee and other harbors. There is not a flaw in the design from beginning to end, as modern experience in the sinking of numerous bridge piers on precisely the same plan has amply demonstrated. It is beyond all doubt that if the design of this working smith had been adopted in lieu of that tendered by Brunel the Thames Tunnel would have been completed in a couple of years, instead of eighteen years, and at a cost of about £300 per yard instead of £1,500.

If another tunnel be constructed under the Thames, which is far from improbable, as the requirements of below-bridge traffic necessitate some such means of communication, I venture to predict it will be built in accordance with the plan suggested fifty-nine years ago by the working smith, and not on that of Brunel's Thames Tunnel, or of any other tunnel yet carried out. After referring to a proposal made in 1805 for a tunnel under the Forth, Mr. Fowler went on:

THE GREAT BRIDGE OVER THE FORTH.

As you will receive a paper on the Forth Bridge from my partner, Mr. Baker, I will not trouble you with details of the proposed structure at the present moment. I may state, however, that after a careful consideration of the difficult problem, in concert with my able colleagues, M. T. E. Harrison, the chief engineer of the North-Eastern Railway, and Mr. W. H. Barlow, chief engineer of the Midland Railway, we unanimously advised the directors of the Forth Bridge Company to abandon the project for a suspension bridge, and to construct a steel girder bridge of the unprecedented span of 1,700 feet. The total length of the structure is one and a half miles, and it includes two spans, as aforesaid, of 1,700 feet, and two of 675 feet over the navigable channels on each side of Inchgarvie. The execution of the work has been intrusted to me, and my intention is that the Forth Bridge shall be not only the biggest, but the strongest and stiffest bridge yet constructed. To realize, however, the important part which rivers play in facilitating inland communication, it is necessary to glance at the other side of the Atlantic. In Canada, for instance, we have the great inland port of Montreal, where Transatlantic steamers anchor some 500 miles from the coast. The very term "stream of traffic" suggests a river, and the St. Lawrence well illustrates it. Into some small forest tributary of the Ottawa the lumbermen slide a log of timber, and many months after will that log, with thousands of others, forming together a huge raft, with huts upon it for the accommodation of the caretakers, be found pursuing its slow but ever continuing progress down the St. Lawrence to Quebec, where it will be shipped to this country.

EGYPT AND THE NILE.

Having filled the office of consulting engineer to the Egyptian Government for seven years, I have had occasion to give particular attention to the Nile, and I may state that in an average year that river conveys no less than 100,000,000,000 tons of water, and 65,000,000 tons of silica, alumina, lime, and other fertilizing solids down to the Mediterranean. The Nile begins to rise about the middle of June, at which time the discharge averages about 350 tons of water per second, and attains in September a height of from 19 feet to 28 feet, and a discharge of from 7,000 to 10,000 tons per second. Napoleon the Great said that every drop of Nile water should be thrown on the land, and he was right so far as Low Nile discharge is concerned. The cultivated lands in the provinces of lower Egypt have an area of three million acres, and to irrigate this effectually at least thirty millions of tons of water per day would be required, an amount somewhat exceeding the whole of the Low Nile discharge. At present the irrigation canals are totally inadequate to convey this quantity, and imperfect irrigation and consequent loss of crops is the result. In many instances a couple of men labor for a hundred days in watering by shadoof a single acre of ground, all which amount of labor might be dispensed with if the barrage of the Nile were completed, and a few other works carried out, the whole of which would be paid for handsomely by a water rate of two shillings an acre. You will gather, therefore, that I do not think the resources of Egypt have yet been fully developed, magnificent as they even now are, having reference to the size of the country.

THE SUEZ CANAL.

It is hardly possible to refer to Egypt without saying a few words about the Suez Canal. Farseeing people, including

* Abstract of the recent address to the Mechanical Science Section of the British Association, delivered by Mr. John Fowler, M. Inst. C.E., President of Section G.

the late Khedive, have long been of the opinion that another ship canal will be required in Egypt. In 1876 I submitted to his Highness, in accordance with my instructions, detailed plans and estimates for such a canal from Alexandria through Cairo to Suez. The total length of the canal was 240 miles, and with the same width as the existing Suez Canal, the estimated quantity of excavation was 160,000,000 cubic yards. An interesting and significant incident in the history of the Suez Canal occurred on May, 1878, when a fleet consisting of ten steamers and sixteen sailing vessels passed through with 8,412 native troops bound from India to Cyprus. During the same year no less than 58,274 soldiers traversed the Canal. Since 1878 events have marched rapidly, for no one then foresaw that the next important movement of the British troops canal-ways would be of a nature hostile in appearance, if not in fact, to the inhabitants of Egypt.

EARLY INCIDENTS IN STEAM NAVIGATION.

The inauguration of steam navigation to India was much delayed by the vacillation of the authorities respecting the Suez and the Euphrates Valley routes. Happily, however, the Arabs stole the first bag of mails that went by the Euphrates, and so in 1834 a committee of the House of Commons finally resolved that "steam navigation between Bombay and Suez having in five successive seasons been brought to the test of experiment, and the practicability of that line being established, it be recommended to his Majesty's Government to extend the line of Malta packets to Egypt to complete the communication between England and India." Nothing appears to have been done during the next two years, but in 1837 a new paddle-wheel steamer, the Atlanta, of 650 tons, steamed out to Calcutta round the Cape in ninety-one days and was put on the Red Sea station. She left Bombay with the mails on October 2, 1837, and arrived at Suez on October 16. The mails were carried across the desert by camels, and down the Nile to Alexandria in four days, where they remained until H.M.S. Volcano took them on board on November 7. At Malta, on November 16, they were transferred to H.M.S. Firefly, and finally were landed in this country on December 4 having been in all sixty-three days in coming from Bombay to England. At the present time about eighteen days are occupied in carrying the mails from Bombay *via* Brindisi to London.

A few months later ninety-four passengers were plucky enough to embark at London, on April 4, 1838, in the Sirius, of 700 tons and 320-horse power, for New York, where they arrived on the 23d, having performed the voyage in seventeen days from London, and fifteen days from Queenstown. The Great Western sailed from Bristol on April 7, and arrived at New York a few hours after the Sirius, and thus was the great problem of steam navigation to America successfully solved by vessels of small size and capable of maintaining a speed of but eight to nine miles an hour.

I need hardly remind you that since the year 1838 the ships conducting the enormous traffic between Europe and America have been of ever increasing size and speed. Thus the Britannic, built in 1874, has an extreme length of 468 feet, a beam of 45 feet 3 inches, a displacement of 8,500 tons, and a speed of 16 knots per hour; while the Servia, built in 1881, has an extreme length of 530 feet, a beam of 52 feet, a displacement of 13,000 tons, and a speed of 18 knots; and the City of Rome, built in the same year, has a length of 600 feet, a beam of 52 feet 3 inches, and a displacement of 13,500 tons. Another Atlantic liner, the Alaska, having a length of 500 feet, a beam of 50 feet, and a displacement of 12,000 tons, attained a speed of 18¼ knots on the measured mile, and has done the distance between Queenstown and New York in seven days four hours and thirty two minutes, and the return voyage in six days and twenty two hours, a mean ocean speed of, say, 17 knots per hour, or more than double that of the first steam vessels trading to America. The present generation has grown so accustomed to the embodied results of the progress of mechanical science that it has long ceased to wonder at big ships, or at any other novelty.

To realize what has been attained it is necessary to place ourselves as far as possible in the position of our immediate ancestors, and to look at things through their spectacles. With this view, and to give you some scale of comparison to measure the size of the present Atlantic liners by, I will quote a short passage from a newspaper of September 19, 1829, where reference is made to a vessel then under construction, of about the size of one of the much abused "cockle-shells" performing the Channel service between Dover and Calais. "The Dutch have been engaged for the last five years in constructing and equipping a steamboat of extraordinary magnitude, in order to facilitate the communication between Holland and Batavia. It has four masts; is about 250 feet long; and has been appropriately called the Monster. In consequence of her great length, she hung when going off the slips, and it was some days before she was fairly launched; a circumstance which gave the wits of Paris occasion to remark that their Dutch neighbors were so determined to excel all other nations in the magnitude of their steamboats, that they had built one so long that it was several days running off the stocks. One of the most remarkable features of this enormous vessel is her extreme narrowness as compared with her length; her greatest breadth of beam being only about 32 feet. The great size of this vessel will bring to the recollection of our readers the Columbus, which was built in the river St. Lawrence in 1824, and made the passage to England in safety, but was afterward broken up on account of her unmanageable bulk. We shall not be surprised to hear that a similar fate awaits the Monster, and for a similar reason."

The Channel boat Albert Victor, now on the Folkestone station, is of the same length as the Monster—namely, 250 feet—while the beam of the former is but 29 feet, instead of what the critic of 1829 termed the "extreme narrowness" of 32 feet.

The successive attempts at mitigating the discomforts of the Channel passage by the swinging saloon and twin steamers of Sir Henry Bessemer and Captain Dicey have gradually prepared the way for what I believe will be the next and important step of establishing Channel communication by means of large floating stations or ferry steamers, capable of traversing the narrow sea between England and France in little more than an hour. Ten years ago I applied to Parliament for powers to carry out this project, and obtained the unanimous sanction of a committee of the House of Commons. The Bill was, however, thrown out in the House of Lords by the casting vote of the chairman.

What was practicable at that time has now become comparatively easy, owing to the introduction of steel into shipbuilding, and the improvements which have been effected in marine engines and mechanical appliances generally. In few departments of the engineer's work has such progress been made as in that of steam navigation. When in 1820 steamships were first used for conveying merchandise as well as passengers, the tonnage of the whole of the steam traders of this country, it is stated, amounted to but 515 tons. At the present time the corresponding figure is 2,500,000 tons.

DR. C. W. SIEMENS.

THE fifty-second annual congress of the British Association for the Advancement of Science opened at Southampton in August last, under the presidency of Dr. C. W. Siemens, F.R.S., whose inventions in the practical application of the laws of physics to the improvement of the iron and steel manufactures, to the construction of the electric telegraph cables, and to other useful processes, have made him eminent among the scientific men of his day. His interesting presidential address on this occasion covers the whole range of recent progress in the sciences. It is given in full in the SCIENTIFIC AMERICAN SUPPLEMENTS, Nos. 351 and 352.

Dr. Charles William Siemens is a German, having been born at Lenthe, in Hanover, on April 4, 1823. He was educated at the Gymnasium of Lübeck, the School of Arts at Magdeburg, and the University of Göttingen. In 1842, he became a pupil in the engine-works of Count Stolberg. He came to England in 1843, to introduce a method of gilding and silvering by galvanic deposit, which had been invented by his elder brother, Werner Siemens; and in the following year the brothers took out a British patent for a differential governor for steam-engines, and one for anastatic printing. Mr. C. W. Siemens remained in England, occupied with railway works, calico-printing works, and improvements in scientific apparatus. Among these was the chronometric governor used at the Greenwich Observatory to regulate the motion of transit and recording instruments. The double-

DR. C. W. SIEMENS, F.R.S.

cylinder air-pump was introduced in 1846. Mr. Siemens next turned his attention to the dynamical effects of heat, and constructed an improved caloric engine, with a regenerator to recover and economize the heat lost at the exhaust port. In 1851, he introduced his water-meter, which is in very extensive use; and from 1856 to 1861, in conjunction with his brother Frederick, produced the regenerative gas furnace, by which steel of the highest quality is manufactured on the open hearth. The furnace, holding a charge of ten tons, will produce twenty or thirty tons of the best steel in twenty-four hours. Dr. Siemens, having applied himself to the object of making steel and iron direct from the ore, established, in 1866, sample steel works at Birmingham, where he contrived the rotatory furnace. In 1868, the great Landore Siemens steel works at Swansea were established, which manufacture above 1,000 tons of cast steel weekly. Having also, for many years, been interested in telegraph engineering, Dr. Siemens, in 1858, with two of his brothers, Werner Siemens and Carl Siemens, and with Mr. Halske, of Berlin, established the great works at Charlton, West Woolwich, known as those of Siemens Brothers. They rival those of the Telegraph Construction and Maintenance Company at East Greenwich. The Indo-European telegraph line, the Direct United States Submarine Cable, the North China line, and the Brazil line, are among those constructed by Siemens Brothers; and their steamship Faraday has done good work in laying such cables in different parts of the globe. Dr. Charles William Siemens became a naturalized British subject in 1859. He was elected a Fellow of the Royal Society in 1862, and was a member of its Council in 1869 and 1870. He was the first President of the Society of Telegraph Engineers, and was re-elected to that office in 1878. He has also for some years been one of the Council of the Institution of Civil Engineers, and President of the Institution of Mechanical Engineers, and has held offices in several of the learned societies. He is the author of a striking treatise upon the theory of the solar heat, which appeared in the *Nineteenth Century* of last April. In 1869, the University of Oxford conferred upon him the degree of D.C.L. He received, in 1874, the Royal Albert medal for his researches on heat, and for his metallurgical processes; and, next year, the Bessemer medal of the Iron and Steel Institute. The honors of a Brazilian and other foreign orders of knighthood have been conferred upon him.—*Illustrated London News.*

THE HORSE AND HIS FOSSIL ANCESTRY.

ONE of the most striking pieces of paleontological evidence in favor of evolution is well known as being presented by the fossil Equidæ. Not wishing to reiterate at length familiar facts, we will merely sum up the peculiarities of this group of animals by saying that *Orohippus*, the earliest known genus of this family, had its fore feet four-toed, the representative of the thumb being alone wanting, though the middle digit is much larger than the others. Its hind feet were three-toed. The remains of this species are found in the Eocene deposits of North America.

In the Miocene Tertiaries occur three genera, all three-toed on both fore and hind feet. One of these (*Mesohippus*) has, however, on the fore feet a rudiment which represents a fourth toe, though it is useless. In *Miohippus* this rudimental fourth toe has disappeared, but the three toes are not strikingly unequal in size, and all of them touch the ground and take part in the functions of a foot. We go a step further: In *Anchitherium* the foot has still three toes, all touching the ground, but the middle one is much larger than the two outer toes put together. All still touch the ground, though the functional importance of the outer digits must have been but trifling.

Another step lands us in the Upper Miocene and the Lower Pliocene. Here occur the remains of another genus, *Hipparion*. Here, though there are still three toes, the two outer cannot touch the ground, and the middle one alone is to be called active.

In the later Pliocene formation we find the fossil skeleton of *Pliohippus* with a foot exactly like that of the *Equus*, the modern horse, which does not appear until the Post-Pliocene. In both these genera there is merely one perfect toe, which is inclosed in a single hoof. The two side toes which we traced in *Anchitherium* and *Hipparion* are now represented by rudiments, known technically as splint-bones.

If we lay these forms side by side, in what may be called chronological order, we cannot deny that there is here a gradual series of changes, departing more and more widely from the typical five toed foot of the Mammalia, and approaching nearer and nearer to the structure of the most recent form of the family, the still living horse.

The general, and we may say the natural, inference drawn from these fossils is, that we have here an instance of those gradual changes of animal forms by which, on evolutionist principles, existing animal "species"—if we may use the word—have been produced.

But this interpretation of the facts is not universally conceded. There are those who contend that though we have never found an *Ancitherium* in the Eocene, a *Hipparion* in the earlier Miocene, a *Pliohippus* in the earlier Pliocene, or an *Equus* in the later Pliocene, yet it is not impossible but that a further examination of the geolgical record may disclose the remains of such—that, in a word, these various forms may have been not successive, but contemporary. The probability is, of course, exceedingly slender, but the advocates of independent mechanical creation may, if so disposed, claim that it should be taken into consideration.

There is yet a further supposition which has been advanced. Admitting, argue some, that these various forms existed, not simultaneously, but in succession, *Ancitherium* having disappeared before—*e. g.*—*Hipparion* came into being, there is still no positive proof that the later forms are descended from the earlier. They may conceivably have sprung into existence independently of each other, the earlier kinds dying out and the later being created in their room. Whatever we may think of the probability of this hypothesis, like the former it is not impossible, and must be fairly met.

It is therefore fortunate that certain recent researches in which Herr A. Nehring has taken a prominent part, and which he has summarized in a paper read before the Berlin Gesellschaft Naturforschender Freunde ("Sitzungsbericht," 1882, No. 4, p. 47), throw an additional and welcome light upon the question.

In the course of the changes which we have just been tracing in the hands and feet* of the Equidæ, it is not only the fingers and toes, and the bones best known as those of the wrist and ankle, which have been gradually reduced in number. Corresponding modifications have taken place in the bones of the fore arm and of the leg. The outer bones of both, the ulna and the fibula, have undergone a corresponding degradation or retrograde development. In *Ancitherium* we find the ulna in proportion strongly developed. The fibula, however, is decidedly weak, and its lower part is applied closely to the inner bone, or tibia; but it is still a complete and connected bone.

In *Hipparion* the process of degenerative change is more advanced. The ulna is so much reduced in the lower part of its central portion, and so closely joined together with the fully developed radius or inner bone of the fore arm, that it is no longer capable of free motion, though it still appears as a complete and connected portion of the skeleton. As regards the hind legs, the fibula of *Hipparion* is interrupted in the middle, and consists of an upper and a lower part no longer connected together.

As we approach more recent times, we find the same changes proceeding further. The ulna of the true modern horse is in its middle portion greatly reduced, and even interrupted, and is connected with the radius in young animals by means of sinews, and in old ones by bony growths.

Now so far it might still be contended, concerning these modifications of the fore arm and of the leg, that they supply no absolute proof of "descent with modification." But sometimes in recent horses and asses we meet with a case of a complete and uninterrupted ulna, just as it occurred in *Hipparion*. Herr Nehring, in proof of this assertion, exhibited to his audience the fore arm bones of a horse of the Cleveland breed and of an adult ass. These specimens showed that in *Equus caballus*, as well as in *E. asinus*, the ulna is sometimes so far developed as to take the form of the ulna of *Hipparion*. Such cases are more common in the horses of heavy breeds than in such of slighter frame: they are also more common in the ass, which seems to represent a more primitive type among the recent Equidæ.

As for the fibula it is so degraded in the recent horse as to consist merely of a rudimentary portion above, and a lower joint-piece which intimately attached to the tibia. Sometimes, however, as in the Cleveland horse above mentioned, the fibula, though not complete, has the interval between its upper and lower remnants much smaller than in the majority of horses—not larger, indeed, than it is found in *Hipparion*.

According to Mr. Steel, in the ass complete uninterrupted fibulæ sometimes occur.—*Journal of Science.*

* It is convenient to speak of the anterior extremities of a mammal as hands, whether they have any power of grasping or not.

ARTIFICIAL FORMS OF SILICA.

SOME curious artificial forms of silica, interesting as illustrating the structure of agates and chalcedonies, have been described by J. I'Anson and E. A. Pankhurst. To illustrate the stalactitic, or exogenous type of agates, the best results are obtained as follows:

"A strong solution of an alkaline silicate is taken, containing a certain amount of alkaline carbonate, and a strong acid (sulphuric seems to give the best results) is introduced by means of a pipette to the bottom of the vessel in which the solution is contained. Bubbles of carbonic acid gas immediately arise, carrying with them a certain amount of the stronger acid. Round the stream of ascending bubbles silica is deposited by the decomposition of the alkaline silicate, and in a very few minutes a tube is formed reaching from the bottom to the surface of the solution. This tube is at first very thin, and through its walls the ascending acid continues to act upon the surrounding silicate, the walls of the tube in consequence constantly growing in thickness by the deposition of additional silica on its outer surface. As long as the flow of acid is kept up, so long does the tube grow in diameter by the deposit of successive layers, and the result is a hollow stalactite ringed in cross section.

"The carbonic acid evolved from the carbonate in the solution is essential to the successful commencement of the tube, but when this is once formed, the sulphuric or other acid can be itself forced through it, and by the application of pressure to the surface of the fluid in the pipette, the action can be kept up for a long time, and stalactites of three-quarter inch in diameter can be formed with little difficulty. The same result can be produced by passing an acid gas, or even air highly charged with an acid, through the alkaline silicate solution, and it will easily be seen that analogous effects can be produced by the action of any other reagents capable of separating the silica, such as acid salts of various metals. In fact, the process can be varied in a hundred different ways. In natural silicious stones, where stalactitic forms enter into the structure, we constantly observe a central core, frequently of iron or other oxide, which appears to represent the original tube which has subsequently been filled up, while sometimes the cavity remains more or less completely as such. These stalactites of course do not grow up by any means in constantly straight regular forms, but assume irregular and branched ones, more like those of coral than anything else, according to the direction in which the bubbles of gas or the acid escapes from the end, or from points of least resistance in the sides of the tube. Glauber's 'Iron tree' is one form of this stalactitic growth . . .

"We consider, then, that the stalactitic productions thus made are the analogues of all the group of banded stalactitic growths which enter so largely into the constitution of many silicious stones, where the growth appears to have proceeded from a central cavity, now frequently only a core by reason of subsequent filling in.

"If the action is carried so far that the surrounding fluid becomes saturated with acid reagent, the whole of this surrounding fluid gelatinizes by the precipitation of amorphous gelatinous silica, and if we suppose a case in which such stalactitic forms have been produced in nature in an inclosed rock cavity containing an alkaline silicate solution, by the infiltration of an acid solution, a like result would occur. In point of fact, as we have already stated, such natural forms constantly occur with a surrounding mass of crystallized unbanded silica, and this we are led by many observations to regard as the analogue in nature of the gelatinous silica resulting from the saturation of the fluid in which the stalactites have been formed. Whether in nature this crystalline silica has been originally deposited in a gelatinous form, and subsequently crystallized, is a little out of the scope of this paper; but analogy leads us to regard this as most probable."

With reference to the banded or endogenous type of agates the authors remark:

"Assuming hypothetically a rock cavity containing a solution of alkaline silicate, and the rock in which this cavity is situated permeated with an acid solution or gas, we should naturally expect to find a layer of silica deposited on the walls of such a cavity, and, as the action continued, more and more silica would be deposited; and if the solution were *inclosed* in the rock cavity, the central portion would, when the action had continued to a certain point, set in an amorphous mass. This action is very completely paralleled in some of the preparations which we have made, and in some of these we have found that a central vacant space was left, owing to there not being enough silica in the solution to fill the whole cavity when precipitated in the gelatinous form. This is precisely what occurs in many natural agates, where we find a deposit of crystalline unbanded silica within the banded portion, with a vacant space in the center of all."

By the use of acid solutions containing various metallic and earthy salts the coloring of natural stones can be imitated, that is, jaspers, moss agates, onyx, and so on. The horizontal banding frequently met with in natural agates has been also very completely reproduced. When the precipitated silica in these preparations is exposed to the air it for the most part dries up and crumbles away, although some forms, closely like common opal in appearance but of lower specific gravity, have been produced. Under suitable conditions as to heat and pressure the authors think that the natural agates and allied varieties might be imitated, not only as here in form but also in hardness and stability.—*Min. Mag.*

LIQUEFIED ETHYLENE.

L. CAILLETET gives an account of some of his experiments on the use of liquefied gas, particularly ethylene, for the production of low temperatures.

Ethylene is liquefied at +1° by a pressure of 45 atmospheres; its critical point is in the neighborhood of +13°, while that of carbon dioxide corresponds to +31°. These properties led Cailletet to determine whether a more intense cold could not be produced by liquefied ethylene than by liquefied nitrous oxide. In order to compare these temperatures, he made use of a thermometer with an arbitrary scale, filled with carbon bisulphide. When plunged in liquefied ethylene this thermometer indicated a temperature corresponding closely to −105°, far below that caused by liquid nitrous oxide, which is −88°.

The ethylene used in the experiments was prepared in the usual way by heating a mixture of alcohol and concentrated sulphuric acid, and after being purified by passing through cold sulphuric acid and caustic potash solution, to remove the ether and sulphur dioxide, was compressed by means of a powerful pump, designed by M. Cailletet, in bottles previously tested by a pressure of several hundred atmospheres. By this apparatus, ethylene was readily liquefied, but its employment in the liquid state presented serious difficulties for when the attempt was made to draw off the liquid ethylene from the bottle in the ordinary way, as with nitrous oxide, no trace of liquid was obtained, and it was therefore necessary to devise a special apparatus in order to make use of it as a source of cold.

When liquid ethylene is allowed to escape from the receiver in such a manner that the liquid drops strike directly against the apparatus to be cooled, there is no great loss of the liquid, and the temperature is further lowered by the expansion of the gas not liquefied. These conditions are best realized by fixing the receiver containing the cooled liquid ethylene in an iron support, and attaching to the orifice of the receiver, directed downward, a tube of glass of 5 or 6 mm. diameter, bent at a right angle. When the stop-cock is opened the compressed gas and the liquid are projected with moderate velocity against the apparatus to be cooled.

Liquefied ethylene, by evaporation at the atmospheric pressure, can then produce a cold more intense than has hitherto been realized by any other means; it possesses the advantage, moreover, of remaining liquid and transparent at temperatures at which nitrous oxide and carbon dioxide become solid and opaque.

In experimenting upon the liquefaction of oxygen with the aid of liquid ethylene, M. Cailletet has obtained interesting results differing entirely from those previously observed by him when nitrous oxide was made use of as a source of cold. In the latter case, when the tension of the compressed oxygen, cooled to −88° by means of liquid nitrous oxide, was suddenly diminished by allowing a portion of it to escape, there was produced a light cloud which disappeared immediately on stopping the escape of the gas; when, however, the oxygen was cooled to at least −105° by means of liquid ethylene, there was noticed an appearance of tumultuous ebullition which lasted for quite an appreciable time, and which resembled the sudden projection of a liquid into the tube.

M. Cailletet hopes to produce still lower temperatures by condensing, by means of the apparatus now at his disposal, gases more difficultly liquefiable than ethylene.—*Comptes Rendus*, 94, 1224.—*Amer. Chem. Jour.*

ON THE LIQUEFACTION OF OZONE.

MM. P. HAUTEFEUILLE and J. CHAPPUIS have experimented upon the liquefaction of ozone, using for the purpose the apparatus of M. Cailletet mentioned in the preceding note.

A study of the conditions under which a sudden diminution of the tension of a compressed mixture of oxygen determined the formation of a cloud led them to the conclusion that pure ozone would be little more difficultly liquefiable than carbon dioxide, and they found that the addition of carbon dioxide to the mixture of the gases yielded by compression a liquid colored pale blue, which coloration they attributed to ozone liquefied at the same time with the carbon dioxide. From these facts they concluded that it was possible to obtain ozone in the liquid form, and that the liquid would be strongly colored. Their conclusions have been fully confirmed by experiment, and they have obtained ozone in liquid drops of a deep indigo blue color; this liquid, they state, was preserved for more than 30 minutes under a pressure of 75 atmospheres, its evaporation not being very rapid even under the atmospheric pressure.

The liquefaction was accomplished by compressing to about 125 atmospheres a mixture of ozone and oxygen in the receiver of the apparatus of M. Cailletet. To this receiver was attached an upright capillary tube, the upper part of which was curved back upon itself so that the descending branch could be exposed to a jet of liquid ethylene, by which means it was cooled to a temperature probably below −100°.

On experimenting with a gas containing not more than 10 per cent. by weight of ozone, the gas compressed to 125 atmospheres was not appreciably colored in the ascending branch of the tube, while in the cooled portion the blue coloration was very decided. Upon allowing a portion of the gas to escape suddenly the tube instantly became colorless, and in the drawn-out portion at the end there was formed a drop of deep indigo-blue colored liquid; the ozone in the tube being almost totally condensed there, as a further compression to 150 atmospheres did not give an appreciable color to the cooled tube. Once liquefied, ozone will preserve this state for a considerable time in a capillary tube, even at the atmospheric pressure, and can be examined either in the jet of liquid ethylene or by withdrawing the tube from it for a short time. The deep blue liquid diminishes little by little in volume, its vaporization being so slow and its diffusion so rapid that the gas appears colorless above an almost black liquid, and it is only at the moment that the last traces of the liquid disappear that it can be seen that an azure blue gas is produced. The vaporization of the liquid ozone brings the whole apparatus back to its initial state, provided the ozone has not been slowly decomposed by the mercury used in compressing the gas.—*Comptes Rendus*, 94, 1249.—*Amer. Chem. Jour.*

THE DETECTION OF ADULTERATION OF METALLIC NICKEL BY THE MAGNET.

By Prof. THOMAS T. P. BRUCE WARREN.

THROUGH the kindness of Matthew Gray, Esq., president of the institution, I borrowed from the India-rubber, Gutta Percha, and Telegraph Company, Silvertown, a specimen of nickel cubes, which consisted, in fact, of two samples received some time ago from Germany. The difference in price of these two samples was so little that they were thrown together into a drawer, as it was thought there could not be much difference between them with respect to purity, etc.

A handful of these cubes was placed on the table, and on bringing an ordinary compound horse-shoe magnet near the cubes, I was very much surprised to find that, while some of the cubes were forcibly attracted by the magnet, others were not affected at all, or so slightly that they could not be supported by the magnet against their own gravity. Some cubes were attracted slightly when placed very near to the magnet but could not be lifted.

I thought the matter was of such sufficient interest that I intrusted the chemical examination of these samples to one of the students in the laboratory of the institution.

I afterward examined the whole of the nickel contained in the drawer with the magnet in the same way, and in two or three minutes I had the samples sorted out into their original lots of two kilogrammes each.

The magnet readily picked out the better quality at the rate of twenty or thirty cubes at a time, until what was left could not be drawn out by the magnet. To make sure of the result the "magnetically selected" cubes were again tested with the magnet, when it was found that a few non-magnetic cubes had been drawn up by entanglement with the others. By the second operation the separation was perfect.

There was no very marked difference in the appearance of these cubes which would lead one casually to suspect anything worth noting. A closer examination showed that the non-magnetic cubes were a trifle whiter, and presented the absence of a striated structure, which was well defined, though in an unequal degree, in the magnetic cubes.

The method of examination was extended to samples of English grain nickel, and also to portions of anodes used in nickel plating. The anodes were of English, American, and German manufacture.

It may be sufficient to remark here that the grain nickel was powerfully magnetic, and, like the magnetic cubes, showed distinct polarities. The anodes, although magnetic, were much weaker than the grain sample, but appeared to be attracted equally by the magnet.

The chemical examination of the grain nickel and the anodes here referred to, as well as the double ammonia salts used in plating, will be omitted in the present communication.

The fact that nickel has now become an article of considerable commercial importance, and that chemical analysis has disclosed the fact that this metal is liable to an extensive adulteration, and which can be so easily detected by the magnet, led me to believe that this subject deserved a more extended examination.

There is no doubt but that with some of the other metals which are magnetic we may hope to gain information with regard to their purity or adulteration.

For convenience, it will be well to divide the following portion of this communication into two parts. In the first part I propose to deal with the chemical examination of the two samples referred to in the earlier part of this paper, and also to the chemical composition of the anodes and salts used in nickel plating. In the second part of the paper I propose to refer to some experiments which I have made with a view of ascertaining the effects of different metals on the magnetic property of metallic nickel. This part of the investigation will probably lead to an explanation of the singular behavior of alloys containing this metal.

I have not thought it necessary to give here the details of the analytical methods I have adopted, as well as the precautions which have appeared necessary to eliminate any sources of error in the analytical operations.

The following table gives the percentage composition of the two samples of nickel cubes:

	Magnetic.	Non-magnetic.
Copper	0·083	33·779
Carbon	0·071	0·365
Silica	0·409	0·160
Iron	2·457	0·841
Arsenic	0·117	0·865
Tin	0·749	0·461
Nickel	96·670	63·690
	100·556	100·161

Special examinations were made for lead, bismuth, antimony, zinc, cobalt, and sulphur, with negative results, although some of these have been detected in samples of anodes.

A portion of pure oxide obtained from the non-magnetic sample was reduced by heating in a current of hydrogen gas, and which appeared to be even more magnetic than the other sample. This reduced metal, placed in a test-tube and inserted between the poles of a strong horse-shoe magnet, readily took up an axial position, which was not disturbed on carefully rotating the tube.

On heating a portion of this metal with arsenic, tin, or antimony, even in very small quantities, the tendency to assume the axial position was decidedly diminished. I have endeavored to find out to what extent this effect can be carried by alloying the pure metal with the extreme metals of the diamagnetic series.

I have no doubt that this investigation will throw considerable light on that curious phenomenon so well known to electricians, though not explained, that German silver wire becomes thoroughly brittle after a current has been passed through it for a few hours.

As nickel is adulterated so largely with copper, it is easy to explain the great variation which is met with in the specific resistance of German silver wire obtained even from the same manufacturer.

THE APPLICATION OF THE SPECTROPOLARISCOPE TO SUGAR ANALYSIS.

MR. WALLACE GOOLD LEVISON, director of the Cooper Union Laboratory, New York, lately suggested an application of the spectropolariscope which Mr. John Loeber, of the Brooklyn Sugar Refinery, has demonstrated to be practical, and possibly of great importance.

Many persons fail to become expert operators with the saccharometer, because they are incapable of distinguishing changes in the transition tint so nicely as a close reading of its scale requires. Any person can read with at least fair accuracy, and with great rapidity, Mr. Levison says, as follows: Adjust a Schiebler saccharometer to zero, remove the eyepiece, and insert in its place a pocket spectroscope, with the slit horizontal or at right angles to the line, bisecting the chromatic field. Looking, then, in the spectroscope, two vertically dispersed parallel spectra will be seen separated by a well-defined black line, which is the image of the line bisecting the colored field. The spectra will closely resemble ordinary white light spectra, except that a narrow deep black absorption band will be seen crossing both spectra in the neighborhood of the D line. The least turn of the reading screw will destroy the coincidence of the two absorption bands, which will no longer appear in a straight line, but one will move upward and the other downward, and if the screw be considerably turned one will pass out of its spectrum into the ultra red, and the other out of its spectrum into the ultra blue, the spectra otherwise remaining unchanged.

To determine the percentage of a sample of sugar by this method, bring the two absorption bands to coincide, insert the solution of sugar, restore the thereby disjoined bands to coincidence again by means of the reading screw, and the scale will give the percentage required. When the solution of sugar is introduced, multiple spectra may be developed, but no confusion need be thereby caused if the two middle spectra only are observed. By a specially constructed instrument it may be possible to more sharply define the edges of the absorption band obtained, and thus render the method absolutely exact. Mr. Loeber proposes to test the practicability of the process fully, and further details may be shortly developed.

A NEW FORM OF CONSTANT PRESSURE INJECTION APPARATUS.

IN studying the circulatory system, the means of injection are an indispensable aid. This operation can be performed in several different ways, but the most satisfactory method would of course be that which would in the simplest manner utilize the materials used and at the same time place them under the most perfect control of the operator.

In the piece of apparatus described below, the wants of my laboratory have been especially consulted, and the object kept in view was the construction of a machine which would perform the most delicate injections in a satisfactory manner. In a sense, it may be said that this object has been realized; but, as the element of good judgment can never be made part of a machine, the degree of success will still be in proportion to the skill in manipulation.

All such machines must have a certain similarity in their construction, but may differ essentially in the arrangement of their several parts, and for this reason no great originality is claimed for the apparatus. The method of the operation in the machine under consideration is as follows:

We will suppose the animal or organ to be injected to have been prepared as is usual and placed over a water bath arranged to secure a proper degree of temperature during the operation, and, the injection mass having been also previously prepared and placed in a three-mouthed Woulfe bottle (prepared as a wash bottle with closely fitting rubber corks), which should, of course, be placed over a water bath to keep the mass liquid.

The source of the power utilized is twenty pounds of mercury, which, by changing position from a higher to a lower level, forces the air out of one of two globular glass filtering funnels alternately, as one placed below or raised above the level of the other, which should be kept stationary. These two filtering funnels are supported on iron rings with clamps, which can be attached to two iron rods at any given height. The iron rods should be about thirty-six inches high, being held in their places by a framework that rises on the back part of a wooden platform which rests upon the table (or may be built into the wall, or placed between two shelves far enough apart in a closet in the laboratory) and serves as a convenient place for any accessory apparatus or instruments. The funnels referred to above are connected at the bottom of each by a rubber tube, and have stopcocks above the points where the tubing is attached. The opening at the upper part of these funnels is closed with rubber corks, through which a glass tube is placed after having been once bent at right angles.

The means of securing the operation of the currents of air in such a manner as to perform their work properly is an arrangement of three-way stop-cocks of a peculiar construction. These stop-cocks are each so constructed that when turned in one position they have the form of a regular spigot, while by a quarter turn from that position, a straight connection is made through the body of the stop-cocks to a tube opening at that point.

Two of these stop-cocks are placed, one on either of the upward branches of a glass tube having the form of the letter Y.

This arrangement affords the means of transmitting a current of air under pressure through that stop-cock which may be turned so as to open a straight connection through it, when that branch of the Y tube, of which it forms a part, has been connected with the glass tube at the top of the filtering funnel, from which the air is forced by the flow of the mercury to it from the other funnel, which should occupy a higher position. It also affords the means of allowing a current of air to flow to the surface of the mercury in the higher vessel, through the other stop-cock, which should be turned so as to afford ingress to the air; this will be secured when the stop-cock is placed in a position at right angles to that of the first described stop-cock. This branch of the Y tube should be connected with the tube at the top of the other filtering funnel.

The lower branch of the Y tube should be connected with the short arm of the bottle containing the injection mass.

All the joints made with the tubing should be securely wired, and all the other connections made as tight as possible.

The Y tube, described above, should be securely supported by extension test-tube clamps, attached to the iron rod to which the stationary filtering funnel has been fixed, and below the funnel.

The long arm of the bottle containing the injection mass should be attached to the nozzle-stop-cock which fits the canulæ to be used in the injection.

Now, we shall suppose that the mercury has been placed in the stationary filtering funnel, and this latter firmly fixed a little above the middle point of one of the iron rods.

The stop-cock of this funnel should be turned so as to prevent the mercury flowing from it, then the three-way stop-cock connected with it should be turned so that the air may have access to the surface of the mercury, and the other three-way stop-cock turned so that the air from the funnel with which it is connected will flow directly through the glass tube to the Woulfe bottle.

Then, if the second filtering funnel be placed in a lower position than the first above described, and clamped securely, the machine is ready for use.

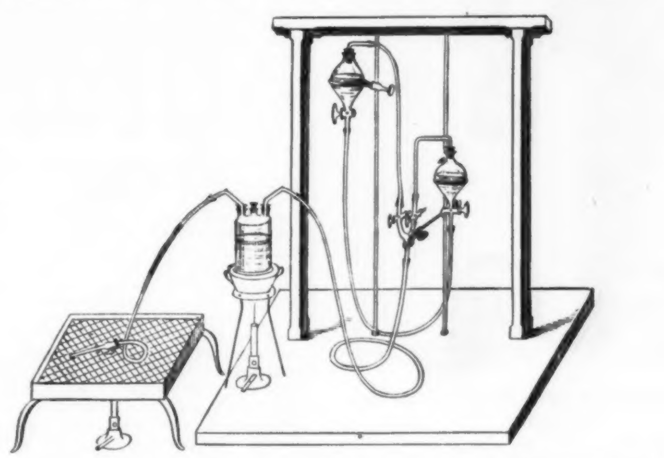
If the mercury should then be turned on, it will force the air out of the lower filtering funnel, and this air will then act upon the injection mass, forcing it along in proportion to the difference in level of mercury, or the amount of mercury turned on.

If a larger quantity of injection mass is required than can be discharged from the Woulfe bottle by once emptying one funnel into the other, after the flow of mercury has been stopped by turning the stop-cock of the lower funnel, an additional quantity of the fluid can be poured through the central mouth of the Woulfe bottle.

The positions of the three-way stop-cocks should now be reversed to permit the current of air to act from the other funnel upon the injection mass.

Then the funnel, which is full of mercury, should be raised to a position on its rod as much above that of the stationary funnel as it was below it before, when it will in its turn become the source of power when the mercury is turned on. Thus the operation may be proceeded with, and by repeating this simple process an injection may be performed, lasting any reasonable time, with very little trouble or interference on the part of the operator, and, as far as my experience goes, with great satisfaction.

It will be readily seen that absolute constancy of pressure is not even obtained in this instance, because the shifting lines of level of the surface of the mercury in the firmly fixed funnels introduces a small error; this might be overcome by suspending the funnels from springs so adjusted that as the mercury changed its level, a compensation would be brought about by a change in the position of the funnels; but after having tried the firmly fixed funnels and not having experienced the slightest difficulty from this source of error, I am inclined to believe that a change would be an almost needless refinement of accuracy, and in addition would somewhat doubt the prudence of having such a weight of mercury suspended in that manner.



A NEW FORM OF CONSTANT PRESSURE INJECTION APPARATUS.

The piece of apparatus has been thus described somewhat at length, in the hope that histologists will find in it an aid in their investigations such as it has been to myself.

WILLIAM LIBBEY, JR.,
Assistant Professor in Natural Science.
Histological Laboratory, Princeton, N. J., June, 1882.

CHEMICAL COMPOSITION OF THE BANANA, AT THE DIFFERENT DEGREES OF ITS GROWTH.*

By L. RICCIARDI.

NOTWITHSTANDING that the fruit of the banana (*Mura sapientum*, Lin.), has already been studied by a great number of savants, among whom were Boussingault, De Humboldt, Buignet, Goudot, Frecul, and Coreulwinder, the analyses made by them did not give concordant results, and did not agree with the transformation of the substances of which it is composed at different periods of its growth. Therefore the author undertook to make a new series of determinations in order to estimate the amount of sugar contained in the fruit which ripened on the plants themselves and in those which only reached maturity after that they had been gathered.

My observations agree perfectly with those of Buignet, because in the first, almost all of the sugar exists as cane sugar, while in the second, it is almost completely composed of the inverted variety.

The analyses are as follows:

THE WEIGHT OF THE FRUIT.

	Green.	Ripe.
Bark	10·25	5·75
Pulp	13·12	15·06
	23·37	20·81

COMPOSITION OF THE BARK OF THE FRUITS.

	Green.	Ripe.
Water at 110° C.	83·83	69·10
Organic substances	14·25	29·23
Ash	1·92	1·67
	100·00	100·00

CHEMICAL COMPOSITION OF THE PULP OF THE FRUIT.

	Green.	Ripe.
Moisture at 110° C.	70·92	66·78
Cellulose	0·36	0·17
Starch	12·06	traces.
Astringent material	6·53	0·34
Fatty substances	0·21	0·58
Inverted sugar	0·08	20·07
Cane sugar	1·34	4·50
Protein substances	3·04	4·92
Ash	1·04	0·95
Other substances by differences	4·42	1·69
	100·00	100·00

COMPOSITION OF THE ASH OF THE FRUIT, AFTER THE CARBON AND CARBON DIOXIDE HAVE BEEN REMOVED.

Silicic anhydride	5·77
Sulphuric anhydride	3·06
Phosphoric anhydride	23·18
Chlorine	traces.
Iron oxide	traces.
Calcium oxide	6·13
Magnesium oxide	9·79
Sodium oxide	6·79
Potassium oxide	45·23
	99·95

We see from the above results: 1st, that the green fruit contains a large quantity of starch, about one-eighth of its weight; 2d, that this substance disappears in the ripe fruit; 3d, that the sugar formed in the fruit which ripened on the plant consisted almost entirely of cane sugar; 4th, that the sugar obtained from the fruits gathered and ripened by exposure to the air is four-fifths inverted and one-fifth cane sugar; 5th, finally, that the astringent substances and the organic acids of the green bananas disappear in the ripe fruit.

In the continuation of my investigations, I allowed two bananas to remain on the branch until the covering became entirely black, then the pulp was removed, and after having thoroughly macerated it in water, it was placed in a Saleron's apparatus, such as is ordinarily used for the determination of alcohol in wine. About two-thirds of the liquid (60 c.c.), were distilled over, and subjected to the usual tests without omitting Lieben's reaction, but the presence of ethylic alcohol remained undetermined.

I have arrived at the conclusion that the carbonic acid produced by the banana, in the third period of its growth, does not proceed from alcoholic fermentation; but in opposition to the assertion of M. Chatue, I agree with M. Cahours that also it is not to be considered due to the decomposition of the astringent matters, because these substances have almost completely disappeared in the ripe fruits. The phenomena which accompany the change of the fruit from its unripe condition to that of maturity are very complex; it would be necessary to make a series of histological studies at different stages of the growth of the fruits in order to ascertain if the development of carbonic acid was due to the changes which take place on the tissues in the third period of growth. Under the circumstances, we are disposed to accept, provisionally, the theory advanced by Liebig, that this effect results from the gradual oxidation of the fruit.—*Comptes Rendus*, xcv., 393. M. B.

* A note presented to the French Academy of Sciences.

APPEARANCES OF THE ELECTRIC ARC IN THE VAPOR OF CARBON DISULPHIDE.

THE authors have already described the modifications which the electric arc undergoes in the vacuum of pneumatic machines, when it is produced by a Gramme machine with alternating currents at high tension. The appearances are modified if gases or vapors are introduced into the vacuum, and are especially remarkable in the vapor of carbon disulphide. When the carbon points are separated, there is a sort of explosion of light, incomparably superior to the ordinary luster of the arc. On viewing it through darkened glasses, we see a dazzling arc of the shape of a horse-shoe, with its extremities at the carbon points, and besides, a long flame, which escapes from the arc and rises vertically. The points of the carbons are red and very bright, but the arc is of a pale green, which predominates. The luster increases so as to become intolerable, as the tension of the vapor increases, but as the resistance of the medium augments at the same time, the arc is often extinguished, and it must be relighted by joining the two carbons. The spectrum is composed of four channeled parts in the red, the yellow, the green, and the violet, so identical that they might be taken for one and the same design transferred from the red to the violet. It is not probable that the light thus obtained will be of any practical value on account of its color, except for lighthouses and signals sent to a distance.—*MM. Jamin and Maneuvrier., in Comptes Rendus*, xcv., No. 1.

DIDYMIUM.

By M. P. T. CLÈVE.

THE author has recently communicated to the Academy a preliminary note, the purpose of which was to render probable the existence of an unknown element between lanthanum and didymium, and accompanying the latter in a certain number of minerals. As a characteristic of this hypothetical element, provisionally designated Diβ, the author gave the spectral ray $l = 4333{\cdot}5$, which is not found among the rays of lanthanum and didymium, as laid down in 1874 by M. Thalen. Continued researches have subsequently convinced himself and M. Thalen that this ray belongs in fact to the spectrum of lanthanum, and that it is omitted in M. Thalen's tables by an error. The latter, in place of this ray, has indicated another adjacent and very strong ray, $l = 4330$, which does not exist in the spectrum of lanthanum. There is here evidently a clerical error, which has misled the author. An examination of the fractions intermediate between lanthanum and didymium has rendered the existence of an intermediate element scarcely probable. It seems to result from the researches of M. Brauner (see *Chemical News*, vol. lxvi., p. 16), that there is a variation in the atomic weight of didymium, which must be ascribed—as M. Brauner in fact does—to the presence of a foreign oxide. If this oxide is new, decipium has yet to be discovered. At present it appears very improbable that it is precipitated by ammonia after the true didymium.—*Comptes Rendus.*

ON DOUBLE REFRACTION IN GLASS AND SULPHURET OF CARBON OCCASIONED BY ELECTRIC INFLUENCE.

By H. BRONGERSMA.

THE author has re-examined the phenomena first observed and described by Kerr in his memoirs on "A New Relation between Electricity and Light" (*Phil. Mag.*, 1875, p. 337), chiefly because certain physicists have failed to obtain the same phenomena as far as solid bodies are concerned. He found, however, that the doubts as to the correctness of Kerr's results are unfounded. If explanations based upon the supposition that electricity produces these phenomena in an indirect manner are not confirmed by an experimental examination, it becomes more and more probable that we have here to do with a hitherto unknown action of electricity upon the luminous vibrations.—*Wiedemann's Annalen.*

CHENOT'S ATMOSPHERIC ROCK DRILL AND HAMMER.

It will be remembered that at the Exhibition of Electricity at Paris, in 1881, there was shown a small atmospheric hammer, which struck 450 blows per minute, through the action of a Gramme electromotor, and which served for the demonstration of a new system of percussion as applied in a rock-crusher invented by M. Chenot and exhibited by M. A. Piat. This crusher, which, like the hammer, was actuated by an electromotor, ran backward and forward in front of a pile of hewn stone consisting of seven blocks of different degrees of hardness, against which the tool successively acted. The results of these experiments were favorable, and have just been practically confirmed, after an operation of four months in an exploitation of the West, where the machine has been submitted to manifold tests. In principle, this new apparatus for sapping rocks utilizes electric power, which permits of carrying the energy of a motor to a great distance. Its essential part consists of an atmospheric hammer in a horizontal position, which is shown in Fig. 1, along with the other parts of the mechanism. The letters in this figure designate such parts as follows:

T R, Intermediate transmission.
T *e*, Belt tightener.
L, Lever of the brake, *f*.
d, Tappet of the brake.
B A, Frame, cast in a piece with the anvil stock, S.
E, Anvil, with stake, T.
A, Crank-plate shaft.
P V, Crank-plate.
B, Connecting rod, with lubricator, G.
P S, Upper piston connected with the rod, B.
D, Diaphragm forged with the cylinder.
P *i*, Lower piston.
C F, Striking cylinder.
1, 2, 3, Air-chambers.
C G, Cylinder-guide.
P F, Stamp holder.
F, Upper stamp.
C, Total travel.
M, Quick rise of hammer.
m, Quick fall " "

Before describing the operation of the new rock-breaker, it will prove of interest to follow the phases of the atmospheric hammer's motions. During a period of rest the brake, *f*, locks the crank-plate, P V; but, as soon as the workman pulls the lever, L, toward him, the brake, *f*, is unlocked, and the tightener, T *e*, acting on the driving belt, gives it the necessary tension to carry along the shaft, A, which at once revolves, and begins to raise the pistons. At this moment the hammer is resting on the anvil. The lower piston, P *i*, on rising, compresses the air in chamber No. 2, and, in the position, M, of the crank-plate, the stamp cylinder is started on its upward travel through the action of the compressed air under the diaphragm, D, of the movable cylinder, C F. The latter, having once started on its upward travel, continues its ascent; but, during this time, the crank passes beyond the upper dead-center, and carries the connecting-rod and pistons downward. As the diaphragm, D, and the upper piston, P S, move with rapidity, they would clash on meeting one another were it not for the upper cushion of air, No. 1, which stops the stamp-cylinder without shock and without loss of effective duty, seeing that the compressed air in chamber No. 1 restores to the said cylinder the mechanical power with which it was charged at the time of its compression. The expansion of the air constitutes an instantaneously acting spring, since at 250 revolutions per minute a shock lasts but about a fortieth of a second. The striking cylinder, impelled with great force against the anvil, produces a shock, then, which is so much the stronger the quicker the shaft, A, revolves, and which is in accordance with the law of the square of the velocities. As soon as the blow has been struck, the hammer at once rises. It regulates itself automatically, according to the thickness of the piece to be forged, through the variation in the compression of the air in the chambers of the stamp cylinder. An immediate stoppage of the tool, or proper degrees of velocity, are obtained by means of the lever, L.

Fig. 2 gives a perspective view of the stone crushing machine, less the windlass for operating the chains. On two American rails, laid in front of the rock-facing, slides a support perpendicular to the track, on which latter it is guided by cast-iron grooves. The upper part of the support terminates in two longitudinal planed arms that perform the role of a slide, to the right and left of which are the planed slides belonging to the cylinder guide of the hammer. The small transverse shaft running across the guide is turned by a winch. It is provided with an endless screw that gears with a wheel whose vertical axle carries beneath a pinion which actuates a rack fixed laterally to the slide support. According as the pinion revolves to the right or

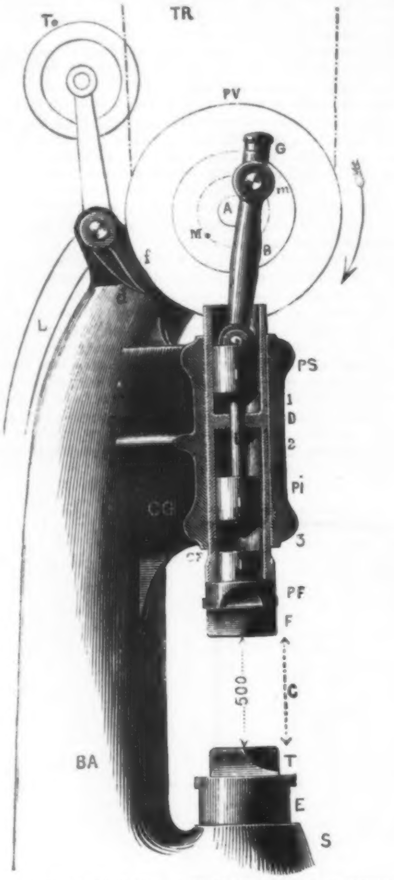


FIG. 1.—DETAILS OF ATMOSPHERIC POWER HAMMER

left, the guide is carried backward or forward along the support. By this means the striking device may be moved to any desired point, so as to penetrate deeper into the rock.

For moving the machine parallel with the rock facing, M. Chenot has adopted an original device which consists in passing the lower part of the hauling chains in the hollow of each corresponding rail, and directing the upper over pulleys fixed to the extremity of the rails. The circuit is completed by attaching the two ends of each endless chain to the slide support.

By means of a windlass whose lower axle may be coupled with the chain pulleys, the chains are drawn in one direction or the other, and the platform is moved along with its entire contents. Owing to the rapidity of the atmospheric hammer's blow, the shifting of the machine in front of the cutting in no wise interferes with the tool, so that the latter touches the rock for a mere fraction of a second, and is instantaneously drawn back to be impelled swiftly forward again.

While at work, if the hammer gives 240 blows per minute, there are, then, 8 to-and-fro motions per second. Now, the crank passes through about one-sixth of an arc to draw the hammer back, and about the same to thrust it forward, so it results that the contact of the cutter with the rock cannot be over $\frac{1}{6 \times 8}$ or $\frac{1}{48}$ of a second. So the striking of the tool and the shifting of the machine in front of the cutting are in practice absolutely independent. The hammer, then, may run at different speeds and the shifting windlass be revolved at a proper speed, without one of the motions interfering with the other. This is an important point; for rocks, even those of homogeneous appearance, possess variable resistances that cause inequalities in the penetration of the mining tool. But, by reason of the rapidity of contact of the tool with the rock, the shifting motion is effected without difficulty, even if the tool is striking in deep places. When the tool is acting on outcroppings of the rock it is the elasticity of air in the back chamber of the striking cylinder that compensates, through its compression, for the diminution in travel. For equalizing the back of the cutting it is only necessary to substitute a tool of special form for the ordinary one. With ordinary rocks the fragments detached at every stroke of the tool fly to a few decimeters behind it and leave the way clear. Soft rocks, like coarse limestone, marly gypsum and chalks, compact marls, etc., although impregnated with water, are easily detached by the tool. This latter works a sort of channel in them, which may be kept free by often cleaning it out during the running of the machine.

Finally, if the tool strikes pockets or crevices that offer no resistance, the hammer makes the forward stroke in such particular cases, just as it makes the return one, the cushion of air, through its momentary compression, compensating for the accidental disappearance of the rock's resistance. In all cases in practice, the drilling tool always remains free.

In what precedes, we have presented the mode in which the new rock crusher works, leaving aside the question as to the motor that runs it. It now remains to examine how electricity intervenes to actuate the apparatus.

The first application of the transmission of power by electricity, which was made by M. Hippolyte Fontaine in 1873, was the starting point for the experiments at Sermaize, in which Messrs. Chretien and Felix showed the advantages of a new mode of plowing by means of apparatus that we figured and described in 1879. These machines embodied a system of traction by friction which M. Chenot now utilizes for actuating his rock crusher, and the arrangements of which he has modified to meet the requirements of this special application. Thus the electro-motor is stationary instead of oscillatory, and is bolted to the platform, which is cast in a piece with the upper part of the hammer-guide. The axle of the motor is provided with two pulleys of compressed paper. The friction plates, which are of wide diameter, are placed as shown in the engraving (Fig. 2), being mounted on the extremities of an upper shaft, which is connected with two flat-iron side-levers. The extremities of these latter are keyed to a horizontal shaft that constitutes the fourth side of a parallelogram oscillating around a long bush behind the platform. A vertical handle, seen to the right of the first friction disk, is keyed to a small eccentric shaft which it controls, and which, through two light connecting rods, causes the shaft to approach or recede from the friction disks, and these latter from the pulleys of the electro-motor.

The current being established by means of a commutator, the electro-motor begins to rotate very rapidly. If, at this instant, the handle be pushed forward, the friction disks come in contact with the pulleys of the electro-motor, and motion of the machine at once begins with a speed varying according to the pressure exerted by the conductor. Such speed may be raised to the degree desired without difficulty in proportion to the necessities of the work.

The transmission of motion between the shaft of the disks and the axle of the hammer, situated at the back extremity of the guide, is effected by means of two pairs of pulleys and two belts. While the friction disks are distant from the motive pulleys, the belts are moderately taut; but, on the contrary, when the disks are carried forward to start operations, the belts have the tension necessary to prevent slipping.

As soon as the workman lets go the lever handle, the belts, acting like a spring, draw the friction disks back, and motion of the hammer ceases.

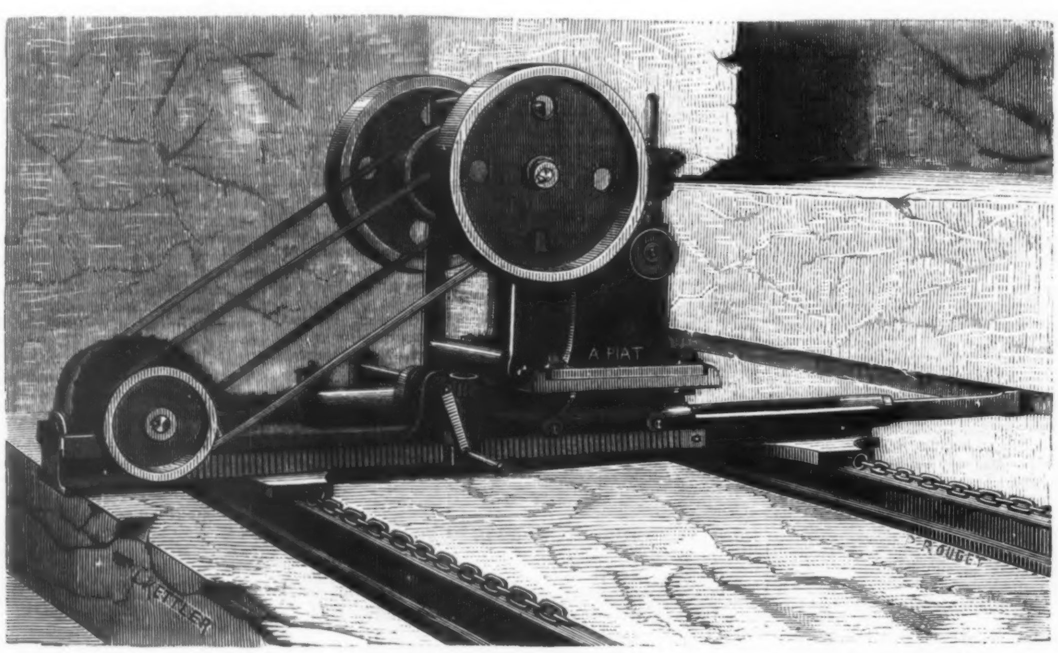


FIG. 2.—CHENOT'S ATMOSPHERIC ROCK DRILL ACTUATED BY ELECTRICITY.

The running of the crushing hammer is effected, then, by means of friction apparatus, combined with the use of belts. For this reason, the bobbin of the electro-motor is not submitted to sudden impulsions that might cause serious damages. Experience, which is in accordance with theory, demonstrates in fact that an electro-motor should not be instantaneously charged with too great a mechanical resistance, nor be stopped short while running by a non-elastic brake. From this point of view it must be further remarked that the motive pistons of the hammer do not carry along the cylinder directly, but act upon elastic cushions of air.

During the entire duration of the tests, which were purposely made severe, the bobbin of the electro-motor remained constantly cool. The striking mass of a weight of 70 kilogrammes readily gave 250 blows per minute. The current was furnished by a gramme machine located at a distance of 500 meters. The circuit was formed by means of a copper conductor running on poles without porcelain insulators. Near the rock-crushing machine this terminated in 50 meters of insulated cable, that might be dragged along the rock without danger to the workmen.

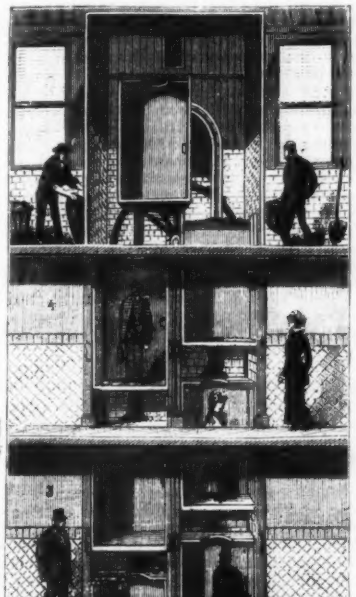


FIG. 1.—HART'S CYCLIC ELEVATOR.

It was found possible to supercharge the striking mass by 40 per cent. without heating the bobbin; and the velocity fell from 180 to 120 blows, according to the supercharge. From these trials it has been ascertained that the transportation of power by electricity into mines or quarries gives excellent results. Compared with the use of compressed air, the expense of the first installation is less with electricity, and the effective work, measured with the tool, is more favorable. Besides, the electric cables do not interfere with maneuvers in front of the cutting.

As an example of the work executed by the atmospheric hammer in a quarry, at 80 meters depth, we may cite a horizontal channel that was cut into the base of a mass of hard quartzose schists for a length of 25 meters. The block thus sapped was nearly 4 meters in height, and weighed about a hundred tons. The tool of this machine is capable of reaching a depth of two meters.

The results of experiments with this machine have permitted a second type to be studied, which is calculated to use a large octagonal gramme machine for actuating a hammer of 300 kilogrammes striking mass. To give some idea of the power of this machine, it is sufficient to state that it is capable of forging a mass of iron 25 centimeters thick.—*Revue Industrielle.*

HART'S CYCLIC ELEVATOR.

WE reproduce herewith, from *La Nature*, a series of cuts illustrating a novel kind of elevator which has been devised by Mr. Hart, of London, and adopted in some of the higher buildings of that city. To give an idea of Mr. Hart's ingenious system, we may liken it to the ordinary chain of pots. But here the pots are replaced by oblong cars, open on one side, and of sufficient size to hold two persons (Fig. 1). These cars, which are arranged in succession along an endless chain, rise on the left, and descend on the right after they have reached the end of their travel above. Hence the name *cyclic elevator* that has been given the apparatus.

There is one difference, and a very essential one, between this elevator and the chain of pots with which we have just compared it; for each bucket of the latter, when it has reached the end of its travel upward, turns over as it descends and pours the water it contains into a trough. Now, as may well be imagined, it would not do for the car when it has reached the top to pour out its occupant in the same way, throwing him suddenly on his side, and then

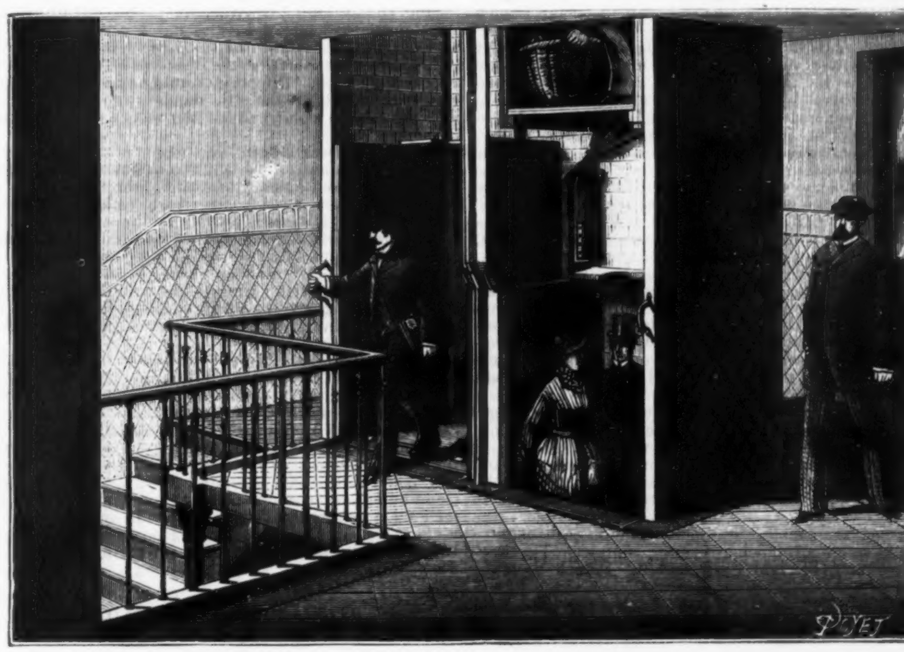


FIG. 2.—THE CYCLIC ELEVATOR.—VIEW OF THE CARS AT THE UPPER STORY OF A LONDON HOUSE.

standing him on his head, if he has forgotten to get out at the last floor. To prevent this, the floor of the car always remains horizontal, keeping that position when it has reached the top and moves from left to right to reach the descending side. All this is effected by means of a guiding mechanism which is as simple as it is ingenious.

All that is to be done, then, is to step into one of the cars when it reaches the level of the floor where one happens to be, and to step out when it has reached the desired floor above or below.

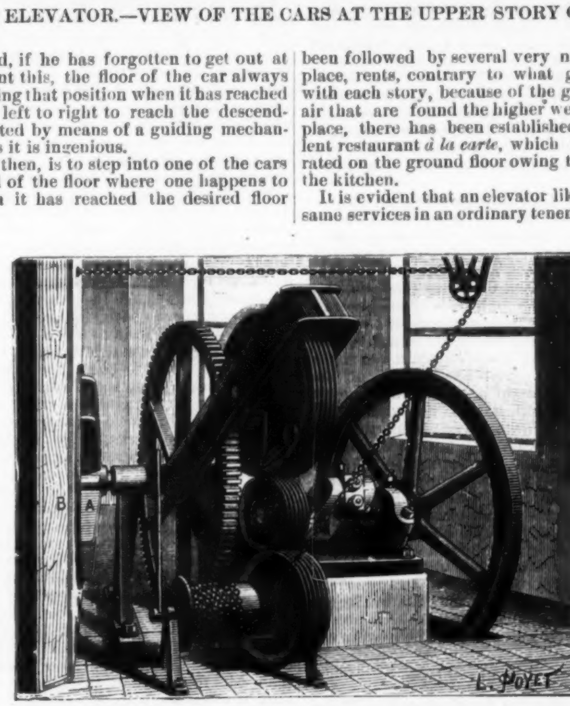


FIG. 3.—MOTIVE POWER OF THE CYCLIC ELEVATOR.

Fig. 1 gives a very faithful general view of the system, shows all the different phases in the use of the apparatus. Between the first and second floors two persons are seen in the act of ascending, and on the first a person is leaving a car. On the third and fourth a lady and gentleman are waiting, the first to get a chance to go down, and the second to go up.

In Fig. 2 may be seen more in detail the arrangement of the car and landing place. The inside edges of the car, like the outer edges of the well, are provided with large handles which facilitate ingress and egress. The speed is about twenty centimeters a second, so that a person has about two seconds to get in or out. This time is amply sufficient to allow any one at all to step in or out of the car. The edges of the landing places and cars are provided with a hinged sill which is raised when any object strikes it. The object of this is to prevent the feet of passengers projecting beyond the edge of the car and being crushed by coming in contact with the different floors.

At the top of Fig. 2 there is seen the lower part of an individual who is lifting a basket. This latter is designed for the motor at the top of the house. This motor (Fig. 3) is a horizontal steam engine of six horse-power, which is amply sufficient to do the work at the busiest period, that is to say, from ten o'clock in the morning till four in the afternoon. The driving axle of the wheel which carries the elevator chain is controlled by means of a gearing and friction wheels. The whole mechanism constitutes a sort of epicycloidal train, in which the movable arm that supports one of the friction wheels makes a slight movement around the axle, A, and proportions the pressure in a certain measure to the mechanical stress exerted. The same mechanism acts also, through a friction gearing, on a windlass and chain which serves to carry up the coal to feed the boiler. The gearing of the windlass with the shaft is effected by maneuvering the lever to the left.

The elevator under consideration, which is in use in the Mansion House Chambers, London, is in operation only from eight o'clock in the morning till ten o'clock in the evening; the tenants of the house during the intervening hours making use of the stairs. But considering the services that the apparatus renders during the period that it is in operation and the size of the building that it does duty for, we may say that there is nothing at present that could replace it. The putting up of this continuous elevator in this building has been followed by several very natural results; in the first place, rents, contrary to what generally happens, increase with each story, because of the greater amount of light and air that are found the higher we go up; and, in the second place, there has been established on the top floor an excellent restaurant *à la carte*, which would not have been tolerated on the ground floor owing to the odors emanating from the kitchen.

It is evident that an elevator like this would not render the same services in an ordinary tenement house as it does in the Mansion House Chambers, where it does service for an incalculable number of offices; but its use is indicated in all large industrial and financial establishments, in large stores, and in cases where a group of tenement houses might desire to share the expense of one of the apparatus in common, and which, in our opinion, would be both advantageous and economical.

PRODUCTION OF LEAD IN 1881.

HERR LANDSBERG, the general manager of the Stolberg Company, has, in an annual report to his company, given an estimate of the production of lead in Europe, for 1881, which is as follows: Spain, 120,000 metric tons; Germany, 90,000; England, 67,000; France, 15,000; Italy, 10,000; Greece, 9,600; Belgium, 8,000; Austria, 6,000; Russia, 1,500; total, 326,500. Herr Landsberg estimates the production of the United States at 110,000 tons. As the output of Mexico, South America, Canada, and Australia is small, it may be assumed that the world's production is about 440,000 tons of lead. This does not include China, which is a heavy consumer of lead, and is not unlikely a producer of some importance; nor does it include Japan, of whose output there are no figures.

THE NEW CHANNEL STEAMER INVICTA.

THE Invicta passed the Dover pierhead Aug. 12, 1882, at 11:34 A.M., and the Calais pierhead after a run, according to one authority, of 1 hour 11 minutes, and according to another, of 1 hour 12½ minutes. On the return trip the distance was run in 1 hour 14 minutes; sea very smooth; faint breeze from the E.S.E.

The Invicta, which is built of steel, is 312 feet long, 33 feet beam, 17 feet 3 inches depth of hold, and engines of 600 nominal horse-power. The engines are expected to indicate 3,900 horse-power. The engine room is 70 feet long, and there are eight boilers. The draught of the ship is 1,251 tons, and the builder's measurement 1,647 tons. The Invicta has an upright stem and stern, and a rudder at each end to enable her to get out of the entrance channel of the port of Calais, in which there is not room for her to turn. Her builders are the Thames Iron Company, and she has been fitted with oscillating engines by Messrs. Maudslay & Field. When taken over she will become the property of the London, Chatham, and Dover Railway Company, which owns all the passenger steamships running regularly between Dover and Calais, although some of them which carry the French mails are obliged to sail under the French flag.

Passengers embarking on board the Invicta in wet weather have entire shelter even while on deck, under the promenade deck, which is the full width of the ship. There are two saloons, the largest of which is 96 feet long. The refreshment room is separated from the cabin, so that sea sick passengers will not be irritated by the sight of persons eating, and the persons eating will not be surrounded by a chorus of sea-sick passengers. The ship has six watertight bulkhead compartments, and is both luxuriously and elegantly fitted up. She has a range aft of fourteen private cabins. Swan's electric light will illuminate the saloons, engine-room, and other parts of the ship between decks at night, and a large electric lamp is fixed upon each paddle box. The two paddle box electric lights will be used only when embarking or disembarking passengers alongside the piers.

The dynamo machines are driven by a Brotherhood three-cylinder engine. The engines of the Invicta have cylinders 80 inches in diameter, 6 feet 6 inches stroke, 30 pound pressure of steam, jet condensers; the boilers have six furnaces each, fired amidships. She is fitted with Brotherhood's steam reversing gear.

As above stated all the passenger steamships plying regularly between Dover and Calais are the property of the London, Chatham, and Dover Company, which, in addition to the Invicta, possesses nine passenger and three cargo boats, five of which sail under the French flag, and are manned by French crews, an imperative necessity to enable them to carry the French mails. The boats steaming under the English flag are manned by English sailors; each country carries its own mail under a separate contract. The English boats carry the night mails, and the French boats the day mails.

The following boats sail under the English flag: The Maid of Kent, paddle-wheel steamer, 200 feet long, 24 feet beam, 334 tons gross, nominal horse-power 160, average speed 15 knots. She is one of the best of the old class boats, and was considered too large for the port twenty years ago. Her three sister vessels, the Samphire, Breeze, and Wave, are of the same construction. All these vessels, which are of steel, were built in 1861–62.

The boats sailing under the French flag are the Foam, paddle, 230·6 feet long, 26 feet 6 inches beam, gross tonnage 497, nominal horse-power 240, average speed 15 knots, built of steel. The Petrel is the same. The Prince is built of iron, 206 feet long over all—she has a bowsprit 24 feet long—horse-power 180. The France, also iron built, is the same. They were built in 1862–64.

The well-known twin ship the Calais-Douvres, which sails daily during the summer under the French flag and a French commander, is 300 feet long each hull, gross tonnage 1,924, extreme beam over all 63 feet, and is driven by two wheels between the hulls, by separate engines. When the wheels are rotated in opposite directions at the same time, the ship turns upon its vertical axis. The nominal horse-power is 600, and the speed 14 knots. In bad weather she compares relatively more favorably in speed with the other vessels, because her wheels are always in the water, and are not so much knocked about by the waves. She is taken off the route in the winter, when passengers are fewer, because she is such an expensive boat to run, but in the summer she works at a profit, irrespective of the circumstance that she also brings traffic to the railway. By her steadiness she reduces the amount of sea-sickness, and apparently by about 75 per cent., so far as average statistics—once carefully collected by the London, Chatham, and Dover Railway Company—can throw any light upon a problem so intimately connected with the uncertainties of organic life.

The three screw cargo boats are the Chatham, built in 1873, of iron, 378 builders' tonnage, 168 feet long, 22 feet beam, nominal horse-power 80. The Calais, built in 1874, is the same. The Paris, built of iron in 1878, is 170 feet long, 22 6 feet beam, nominal horse-power 85. At present three passenger ships run each way daily.—*The Engineer.*

NARROW-GAUGE RAILWAYS.

TEN miles below Woodbridge, on the Moquelumne River, in the county of San Joaquin, is a new shipping port called Brackville. It is the tide-water terminus of a narrow-gauge railway now in course of construction, thirty-five miles being completed and in operation, carrying freight and passengers through the best settled and best cultivated part of the Moquelumne valley—that on which the celebrated Moquelumnes grant was located, known in Stockton as "The Live Oaks." The eastern end of the road is already a little east of the town of Lockford, overlooking one of the richest low-lying bottoms in the country, and not far from the foothills of Calaveras county. The present freighting capacity of the road is taxed to its utmost, and the company are procuring new rolling-stock to accommodate the incoming wheat and barley harvest, always good in that region. It is not the intention to stop the road in the valley, but to build on through the Calaveras foothills, and far into the lumber region at and above the original Big Tree grove, where there are hundreds of square miles of the best sugar-pines in the Sierra Nevada, as yet but little disturbed by the local millmen. The lumbering capacity of this sugar-pine country will supply as much freight as the road can carry for half a century to come, and it is exactly the kind of freight which is needed for the improvement of the valley lands and the trade of this city. Sugar-pine is the most costly of all lumber. It is used for fine cabinet ware, panel doors, window frames, and the flooring and wainscoting of elegant houses. The demand for it is unlimited; but the supply cannot be advantageously tapped without railway communication with the Sierras, at least as far up as an altitude of 5,000 feet above sea level. Broad-gauge railways are too expensive for this purpose. Neither are they well adapted to the high grades and sharp curvatures that must needs be encountered in the mountains. The narrow-gauge meets these desiderata. A road of that kind can be constructed, equipped, and operated for less than half the cost of an ordinary broad-gauge road. This San Joaquin narrow-gauge road is owned and managed by local capitalists of Sacramento and San Joaquin counties. Some of them are merchants, others wealthy farmers, and nearly all of these have interests to be developed by the transportation it will afford to their produce. We understand that they are able, without borrowing or mortgaging the road, to build as far as the Big Trees at least. If they go no further eastward, the timber tapped there will supply freight enough to pay expenses and fair dividends. But there is some hope that in the near future this road will connect with a narrow-gauge system in contemplation for Nevada, to tap the Bodie mines, and to connect with the eastern system of railroads.

Another narrow-gauge railway enterprise is taking shape for the connection of Oroville, Marysville, and Chico, with the high timber lands of Plumas and Lassen counties, and with an outlook toward the extensive grazing and dairy farms east of the Sierra, in the direction of Goose Lake and Southern Oregon. Nicholas Luning, a stout and keen-witted capitalist of this city, stands at the head of it, and will be able to command all the money needed to put it through.

Neither of these roads will cost more than $8,000 to $9,000 a mile in the valley, or over $12,000 to $15,000 in the mountains, save where tunneling and high bridging or deep cutting is required. Broad-gauge roads cannot successfully compete with them, as is proved by the operations of the Santa Cruz narrow-gauge against the monopoly's broad-gauge, which taps a part of the same region that feeds the narrow-gauge. The running expenses are less by 40 per cent. than on the narrow-gauge. It carries less dead weight in cars and engines by 60 per cent., and the wear and tear of material is but trifling by comparison with that of the broad gauge.

It is probable that if relief ever comes to the people of California from the oppressions and insolence of the transportation monopoly, it will come through the medium of narrow-gauge railways, constructed and operated on a cash capital supplied by the local merchants, farmers, and lumbermen directly interested in the construction of short lines for the development of their other business. The farmers and merchants of San Joaquin valley, for an illustration, could build and equip a narrow gauge railway for what their overcharges by the monopoly will amount to in five years. The surplus of a single good crop of wheat and barley would suffice to carry the enterprise through.—*San Francisco Chronicle.*

ARTESIAN WELLS IN SAHARA.*

By P. DE TCHIHATCHEF.

SINCE Algeria (which the speaker visited two years ago) has annexed to France, our knowledge of this country has made very rapid progress, so that the ideas which were formerly entertained of the Saharian Desert have at present undergone an entire change. It has been ascertained that those sand deposits, which hide completely the solid framework of the country, are comparatively local phenomena, and that in the greatest part of the Sahara-Libyan Desert the subjacent strata are perfectly conspicuous, either by cropping out through the superficial deposits or by rising as mountains and hills, which almost all belong to the cretaceous formation, and cover an immense tract of this part of Africa. The regions of Sahara not occupied by cretaceous mountains and hills, consist in large surfaces more or less horizontal, composed either of loose sands or diluvial (quaternary) deposits. Those last seem to have formed so many gulfs, which, after the emergence of the cretaceous masses, remained covered by the sea, and were filled up in a comparatively recent epoch, for they contain shells of mollusks belonging to still living species.

As for the rocks which underlie the sandy deposits, what we know of them is due to the numerous wells sunk by the Frenchmen all along the northern boundaries of the Sahara, particularly in the province of Constantine. The learned engineer, M. Jus, who during twenty years has directed those admirable works, ranges in the pliocene formation the different rocks (limestone, sandstone, marls, gypsum, etc.), crossed by the soundings, as well as the impermeable water-bearing clay which forms the bottoms of the wells. This clay presents the most astonishing discrepancies in its level, being sometimes many hundred feet under the surface of the soil, and sometimes approaching it very near. So, for instance, in the region Ued-Rir, two wells, named Ain-Kerma and Un-el-Thiur, are distant, one from the other, about forty miles, and still the depth of the first is only 44 feet, and that of the second 321 feet. In the country of Houda, the well named Nemechdib is 10 feet deep, whereas the well Barika, almost close to it, is 117 feet. Again, at Batna and at Biskra, the soundings have been pushed through more than 540 feet without reaching any subterranean water, so that the works were abandoned, most unfortunately for those two cities, which are suffering for the want of good water. The same thing happened at Tahin-Bacu, where, at the depth of 300 feet, no water could be reached. We must consequently admit that the pliocene impermeable clay, before having been covered, first by different rocks, and finally by sand, has been exposed to some powerful agents which caused its surface to undergo the most varied changes, so as to produce more or less deep excavations in some places, and to leave others (often quite near the first) in the shape of high conical masses, with hollowed basin-like tops.

Another curious phenomenon which the sinking of the Algerian wells has revealed, is the discovery of fishes, crabs, and fresh-water mollusks at considerable depths. This interesting fact has been ascertained in the artesian wells called Mezer, situated in the desert of Ued-Rir, quite near one of the brackish lakes (Chott or Sobka of the Arabs) which are so numerous in the region between Biskra and Tuggurt. When the sounding line brought those creatures from a depth of 230 feet they were perfectly alive, and M. Jus even boiled a crab and found it of excellent taste. The fishes were covered with sand mud, but the shell of the crabs was quite bright and glittering, a proof that they inhabited pure water. M. Jus showed him all those animals, preserved in spirit, and adorning his rich collections of Batna. The wells constructed by the French engineers numbered at his last visit (1879) in the Province of Constantine alone (and there are many elsewhere) more than 155; and as the works begun in 1856 have never been interrupted, and are rapidly advancing into the interior of the desert, the time may not be far off when all those regions now so barren and so dry, will be copiously irrigated, an advantage which they certainly enjoyed once, seeing that the numerous oases spread over the Sahara and Libyan Desert contain many remnants of Greek and Roman constructions; a proof that once they were populated and consequently provided with water. This was most probably got by means of the same so-called artesian wells, which our modern times presume to consider as their own invention, whereas they were undoubtedly known to the ancients, and were even constructed in the very Desert of Sahara, as it is ascertained by Olympiodoros, a historian whose writings have perished, with the exception of a few fragments quoted by the learned Greek patriarch Photius, one of which contains the following important passage: "In the oasis of Sahara the inhabitants used to scoop out excavations 100 feet and 250 feet deep, from which jets of pure water rise in high columns." But it was not in the Sahara alone that the ancients sunk artesian wells; they multiplied them almost everywhere, and to those artificial irrigations was due the once flourishing state of the plain now so arid, which is covered by the ruins of Balbek (the ancient Heliopolis) and Palmyra. The English travelers, Wood and Darwins, discovered under those heaps of ruins numerous traces of ancient artesian wells, and such traces are so frequent in the Arabian desert crossed by the Hebrews under the leadership of Moses, that several modern authors, among others M. Joberd, are of opinion that the miracle attributed to the celebrated Hebrew legislator of having called forth a jet of water from a rock he struck with his staff, may be explained by the presence of an artesian well previously known to him. Since the invasion of the distinctive Ottoman race, all those monuments of ancient civilization have disappeared, and it is the glorious task of France to make them revive once more in Algeria.

* Extract from a paper lately read before the British Association, Southampton.

FRICTION MATCHES AND THEIR INFLUENCE IN IGNITIONS.

IT seems to be simply the working out of part of a universal law, that whatever increases business and the comforts of civilized life—saving also time, which is money—must, in some way, increase the general fire-hazard. This is shown in the change from the former simple mode of grinding grain into flour and meal, the machinery and processes by which a vastly increased production is attained in the making and coloring of all kinds of textile goods, the brewing of beer and ale, wood-working, modes of printing and making books, journals, and newspapers, the arrangements of chemical laboratories and sugar refineries, etc., etc. In our dwellings, factories, and shops, one of the chief fire risks arises from the improper use of lucifer and parlor matches, as they are called, which together have become indispensable to our modes of living and working. This may properly be considered a recent risk—for within the memory of many who will read these lines, the tinder-box, steel, and flint— which three came into use the fourteenth century—formed the only practicable and general mode of causing ignition. As adjuncts to them were spiral or thin straight wooden splints, with ends tipped with sulphur only, for more rapid kindling.

An improvement came to this ancient mode in the shape of a metallic box about four inches in length, having a sliding cover, and a steel wheel two and a half inches in diameter, supported on light projecting arms at one end of the box. The latter being filled with tinder, consisting of the ashes of burned linen or cotton rags, and the wheel rapidly revolved by the operator pulling toward him a cord wound on the axis, a stream of sparks could be thrown down upon the tinder on applying a flint to the wheel. One of these mechanical tinder-boxes would now be a great curiosity.

A kind of phosphorus match was said to have been scantily used in Paris in 1805; and in 1809 Derepas proposed to mix magnesia with the phosphorus to diminish its inflammability. Even as long ago as 1680, only a few years after the discovery of phosphorus, Godfrey Hauckwitz originated the first idea of a friction match—using a minute piece of phosphorus ignited by rubbing between two pieces of brown paper, and then applying a sulphur-tipped wooden splint. The high price of phosphorus caused this plan to be little used, and soon it slept profoundly for 125 years.

Some expensive modes, but little used, for causing ignition were invented between 1815 and 1830. It will be interesting to review these briefly, as showing the want of a more rapid mode than the steel and flint, and the stimulus to the perfection of the match, toward which crude attempts were being made in Europe.

In 1823, Dobreiner, of Jena, invented a glass jar, holding in its upper part hydrogen gas produced within it and accumulated with pressure. By touching a brass lever on top of the jar cover, a slight jet of the gas was thrown on a small piece of spongy platinum held in a wire cage standing on the cover, and incandescence took place, to be supplemented by the use of the sulphur-tipped match. Another very clumsy and dangerous mode was fusing carefully in a glass tube equal parts of sulphur and phosphorus, the mixture to be kept tightly corked. To use it, a thin splint of sulphur-tipped wood was immersed therein, which ignited spontaneously on reaching the open air. What were called "chemical matches" were sold in London, about 1825, at fifteen shillings for a small box. They were made by dipping the splints of wood first into sulphur, and then into a mixture of chlorate of potash, colophony and gum or sugar, with cinnabar for coloring. These matches instantly ignited on being dipped into a small vial of sulphuric acid accompanying the box. This mode is said to have been in limited use in Vienna as early as 1812.

Another form of these tentative modes was a small bottle into which a piece of phosphorus had been introduced and stirred around with a hot wire, thus coating the interior with phosphoric oxide. The bottle was tightly corked until a light was required, when on immersing a common sulphur match and withdrawing it, ignition occurred. Still another kind of what was then an expensive luxury were the "Prometheans," made about the year 1830, being paper tubes like small cigarettes, having ends coated with a mixture of chlorate of potash and sugar. The cylinder contained a tiny glass tube holding sulphuric acid, on the breaking of which the match would ignite.

The first friction matches were made by John Walker, of Stockton-upon-Tees, England, in 1829, using splints first sulphur-tipped, and then coated with a mixture of one part chlorate of potash and two parts of black sulphuret of antimony, adding some gum. These matches were lighted

by being drawn between two folds of sandpaper; but they were very dangerous, as the heads often flew off and ignited other substances then the splints. They were called "lucifer," or more commonly "locofoco" matches; and through a contest in 1835 between the Whigs and Democrats of New York for the possession of a hall—when the candles were blown out by the Democrats and by them relighted with these matches after their opponents had departed—the nickname "Locofoco" stuck to that party for over twenty-five years.

These crude matches made a loud snapping noise and produced an abominable stench. They were also liable to take fire in the boxes during the jolting of transportation, or even by the concussion of a fall when in ordinary use. This caused their manufacture and transportation to be forbidden for several years in Germany, where the industry had been most practiced. A great improvement was made in 1835, when Trevany substituted a mixture of red lead and manganese for a portion of the chlorate; and in 1837 it was discovered that the matches could be made without that dangerous salt by using instead either peroxide of lead, or a mixture of red lead and nitrate of potash, or peroxide of lead and nitrate of lead.

From this time the making of friction matches became gradually a vast business, which was still more increased when in 1844 the safer and more agreeable kind called "parlor matches" were invented. Many other improvements were made, which, though each was perhaps small, together contributed to make better and cheaper forms. A great quantity of machinery has been invented for cutting square and round splints, binding the splints for dipping, transporting by belts, etc., dipping, returning, sorting, and packing—whereby the production has been enormously increased, the cost diminished, and the liability to disease from contact with the phosphorus and various salts very much diminished among the reduced number of operatives now required. Through the immense demand the industry of all descriptions of matches has become a power in the world; and some idea of the production can be had from the fact that three hundred tons of phosphorus are made in Europe alone—one pound of it will make one hundred thousand matches—and ninety-five per cent. of all phosphorus is used for this purpose. The United States obtains a very large revenue by a one cent tax on each box of matches.

In considering the close connection of friction matches with insurance, the remarkable fact appears that the period 1840—1844, which saw their full introduction into use, was the same when commenced a kind of awakening in the world in regard to rapid transportation (railroads and steamers) and rapid production of goods—in fact, a stimulus in all kinds of business. Along with this new activity, employing many new modes and processes of manufacture, came inevitably a great increase of fires. How much these were increased by the cheapness and ease of obtaining matches, and by facilities afforded to the incendiary, may never be known, but it is beyond doubt that they largely contribute to the increase; and now, besides other accidental causes through their employment, "the careless use of matches" and "children with matches" form two of the principal origins of recorded fires, especially those in cities.

It is singular that although directly and indirectly the cause of many fires, friction matches, if carefully used, and especially if kept in tight tin cases, and when properly packed for transportation, very rarely ignite of themselves. It is carelessness which lends to them their destructiveness, together with such want of thought as will leave them exposed to become, perhaps, gnawed, and thus ignited, by rodentia, or dragged into their hot nests among combustible rubbish, to start "mysterious fires" in the hot months. Not only can the keeping and transportation be safe, but even the manufacture of them does not appear to form a very bad risk. This is the more curious since the drying rooms for the dampened ends of the splints present a serious source of danger. The only probable reason for the immunity must be the constant expectation of fire, and the watchfulness practiced in extinguishing at once any ignitions.

There is in this industry, besides the fire risk, danger to the employes of both sexes and all ages of contracting necrosis, a horrible disease occasioned by the fumes of phosphorus, which substance now forms nearly half of the igniting paste. In this disease, the teeth are first attacked, and eventually all fall out, the jawbone decays, and most intense pain is endured until a surgical operation or death brings relief. In some cases the whole lower jawbone is lost, and in any event, the disfigurement is great, while the lives of those who continue working at the business are much shortened.

The classification of causes of fires shows that in Philadelphia and New York the average annual proportion due to the use and abuse of matches has, of late years, been six to six and a half per cent. of the whole number of fires in those cities. In Baltimore, from official data of the past ten years, the ratio from said cause was just six per cent. Probably the last named is the correct ratio for all the United States, of fires from friction matches. The fires in factories arising from matches among cotton, cotton and woolen waste, paper, etc., together with those from the general use of matches in mills, show a much larger percentage. Of five hundred and seventy-five mill fires, from 1850 to 1882, observed by the manufacturers' mutual fire insurance companies of New England, forty arose from matches, being a ratio of about seven per cent. There were also, doubtless, many other small mill fires there during that period from the same cause, but not recorded. Here should be noted the very heavy fire losses in cotton-ginning and store houses, and in cotton cargoes at wharves in the Southern States—in almost every case friction matches having, in some way, caused ignition.

Actual and supposed incendiary fires, as reported, though varying greatly according to discovery and due punishment, average generally three to four and a half per cent. of all annual fires. In Philadelphia, for four years past, their annual ratio was four and three quarters per cent. Taking two per cent. of all the annual fires everywhere, as the number of incendiary fires caused by the *facilities* from matches—fires which would not or could not have been kindled but for such aid—there appears, from the two causes named, *eight per cent.* as the approximate proportion of all fires whose origin should be ascribed to friction matches.

As among the many fires from "unknown causes," a considerable number may be due to the use or abuse of matches by adults, children, or rodentia, and as these fires are not included in the ratio last named, they will aid in correcting overestimate therein, if there be any. The fire data of continental Europe, though so imperfect as to have often over fifty per cent. of the fires ascribed to unknown causes, indicate that *rural* incendiary fires are much more numerous than the average from that cause in all the United States; and such rural fires are generally total losses. The fires caused by matches in European cities and towns would probably equal the city ratios of the same cause here, but for the generally more solid and slow-burning modes of city construction in Europe. The Prussian fire data in another part of this issue show the ratio of fires from carelessness with matches in city and country there during 1881 was just 4 per cent.; known incendiarism 8·45 per cent. in cities and towns, and 9 per cent. in the country.

The percentages of ratios of incendiary fires in Austria (Hungary not included), ranging backward from the five years, 1879 inclusive, were 4·1, 5·1, 4·7, 4·7, 5·6; and the fire reports of this item, for same term in Germany, will rather exceed these figures. In both these States, which are fair representatives of most foreign countries, the facts of strong police supervision, improved fire departments, and solid modes of building in cities, cause the relative number of incendiary fires in rural districts to make a very large showing. Such considerations, which could be strengthened if we had space for more instances, seem to render inexpedient any reduction below eight per cent. as the supposed general ratio of fires caused directly or indirectly by friction matches.

The ratio named is, indeed, more probably an understatement than an exaggeration. In the United States it would show an annual loss of $7,500,000; and on all the world's fires a loss of at least $15,000,000 annually. These estimates may be reduced from the fact that incendiary fires in cities are now generally so quickly discovered, that (excepting Russia, China, and Japan) such city fires are generally of small proportions; notwithstanding which, the total annual losses from the influence of friction matches will remain of colossal proportions.

The friction match may be considered as an outgrowth of the demands of our present rapid-paced civilization, and perhaps we cannot dispense with it. It is doubtful, however, if the vast annual destruction throughout the world from the careless use and the abuse of matches, besides their aid to the incendiary, and the fearful amount of losses from that crime, be all considered; it is, we say, in a financial view alone, doubtful whether the world is really better for this very useful but rather late discovery. If we view the wrecked lives through diseases, and the poisoning and burning annually of many young children, besides the financial losses, all occasioned by the manufacture and improper use of matches, the destruction which comes from the match-box seems to rival that which spread from the fabled box of Pandora.—*American Exchange and Review.*

HOW TO MAKE PAPER CANES

A CORRESPONDENT of *La Nature* gives the following directions for making paper canes:

First, a steel punch must be procured similar to that shown in Fig 1, and which is to be provided with two

FIG. 1.—PUNCH AND PAPER DISKS. FIG. 2.—PAPER CANE AND METHOD OF MANUFACTURE.

cutting circumferences, the external about one half to three-fourths of an inch in diameter, and the inner one about one-tenth inch. With this tool, paper disks are cut out of books of 15 to 20 leaves in thickness. One of the disks thus made is shown in Fig. 1, under the punch.

Then a steel rod, about one-tenth inch in diameter, having been procured, a thread is cut at each extremity, and each thread is provided with a nut of a diameter smaller than that which the cane is to have. One of the nuts having been removed, each package of disks is successively strung on the rod, and rammed down compactly against the lower nut by means of an iron weight provided with an aperture through which the rod is passed. Fig. 2 explains the operation, and shows the movable hammer above the disks. After all the disks have been put in place, the upper nut is put into the rod and screwed down very tightly. In this way there is secured a paper cylinder which should be as hard as metal, and nearly as heavy. To give it finish and polish, it is then planed, just as if it were made of wood, care being taken to make it taper downward, and give it an even surface which is to be afterward dressed with a file or sandpaper.

Next, the cane is provided with a head, which may be in the form of a geological hammer, like that shown in the cut, or of any other form that the maker's fancy may suggest. To the other extremity there is screwed a solid iron ferrule. Finally, after painting and varnishing, the cane is finished.

As regards the paper, old newspapers and books may be used for the disks, and will give a very pleasant gray tint. By using paper of various colors the cane may be variegated.

PRACTICAL METHOD OF ENLARGING ON CANVAS.

By G. H. MARTYN.

WHEN I originally fixed my attention on the subject I readily realized one fact prior to beginning operations. It was that, in all probability, the surface of the canvas would prove repellent to a direct application of the solution I wanted to use. The sequel proving that I was right, I felt that a gelatinous body would be the precise thing to apply, as I had done in the case of papers, and it turned out I was correct in my surmise. But a plain gelatinous solution does not, as a rule, adhere to canvas as purchased by artists. It is contrary and obstinate in the extreme; and, when casting about for means to overcome its obstinacy, remembering the effect of washing soda over grease, and likewise having before me the customary way in which I use it in the case of collodion transfer, I tried it in view of my present end, and was pleased to find it quite effectual. I cannot do better than to give the proportions at this stage. Surface cleaning solution: I prepare the surface of canvas with the following cleaning solution. A lump of washing soda, the size of a walnut in half-a-pint of water.

With this you first scrub or rub the surface of your canvas (which may remain on its stretcher for this and all subsequent operations), rinse under the tap, and sponge dry. You now find the surface thus prepared will take kindly and at once to the solution properly applied. The substratum itself I found worthy of attention, both as to proportion and mode of applying. It may thus be formulated:

Gelatine	20 grains.
Water	15 ounces.

To this are added a few drops of a saturated solution of chrome alum.

On trying to apply this with a brush it was found the result was not satisfactory, but flowing twice over the canvas was eminently so. It is best to pour on one corner, flow all over, drain and then pour again on the corner diagonally opposite, now well draining to expedite drying. After drying spontaneously the surface is ready for the next operation. The surface is next sensitized with a gelatine bromide of silver emulsion.

The thing to overcome at the outset was the proper way of coating; and practice proved that it was desirable, first of all, to have the emulsion warm enough to flow easily—something like collodion. A glass rod readily removes inequalities, and with it the emulsion is brought over any bare patches that may be remaining after flowing over the canvas. Care should be taken that there is a sufficiency of emulsion to cover the whole surface to start with, or the result must there and then end in disappointment. Any surplus should be carefully drained, as only a film is required and not a thick coat, as in the case of a glass intended for taking a negative. The coated canvas is then reared, with its face to the wall, inside of an absolutely light-tight cupboard, and allowed to dry spontaneously. After drying, a very nice surface will be found awaiting exposure and further treatment.

The exposure is only to be got at by actual experiments, as will readily be understood; and all I should say is that a few seconds (daylight) suffice where minutes are required in the case of transfers. All must feel how idle it would be to attempt to offer anything definite on the subject of exposure, so much depending on different factors—such, for instance, as the state and character of the light used, the objective employed, the emulsion in hand, which, by the way, may be made to suit individual taste and work, quicker or slower, as desired.

If using a good paraffine lamp in a magic lantern, with (say) a four-inch condenser, an exposure of a minute or so will suffice with a good, suitable negative; of course a longer time would be required with one of the old-fashioned negatives, such as were taken twenty years ago.

In a case where one would object to making the emulsion, Mr. R. Kennett's excellent pellicle will supply the want, and all that will have to be done is simply to dissolve the pellicle as directed, being careful to do so, as well as the coating, in a light absolutely secure against all baneful actinic rays, his pellicle being very sensitive. To amateurs this mode of enlargement, when they do not wish to trust their negatives in the hands of strangers, is simply invaluable and capable of yielding excellent results.

Much, of course, lies in the development, and individual taste and circumstances may lead to a modified form of developer to produce given effects. For ordinary purposes the following will be found to answer well:

DEVELOPER.

Hot water	40	ounces.
Salts of tartar	8	"

When dissolved add oxalic acid till neutral.

Citric acid	½	drachm.
Protosulphate of iron	10	drachms.
Sulphite of soda	1	ounce.

Well wet the surface of the canvas before pouring the developer on to make it flow properly all over.

I think the sulphite of soda helps to keep the solution, and likewise prevents precipitation, but this is only my surmise. After developing, wash, and there only remains the fixing, which is done with a saturated solution of hyposulphite of soda, to which is added an equal bulk of water. After fixing well, wash in a gentle stream for (say) half-an-hour, no soaking being necessary.—*Br. Jour. of Photography.*

THE ATOMIC WEIGHT OF URANIUM.

CLEMENS ZIMMERMAN* has prepared metallic uranium by Peligot's method, and determined some of its properties. Its sp. gr. is 18·685, and its sp. heat between 99° and 0° is 0·02765. The latter number multiplied by 240 gives a product of 6·64, which agrees with the mean atomic heat indicated by Dulong and Petit's law. The controversy between the values 120, 180, and 240 for the atomic weight of uranium is thus settled in favor of the highest, and in accordance with Mendelejeff's classification. F. W. C.

* *Ber d. deutsch. chem. Gesell.* 15, 847.

APPARATUS FOR INSTANTANEOUS PHOTOGRAPHY.

THE apparatus used by me for taking instantaneous views has a very peculiar arrangement. The copper tube of standard form, which holds the lenses, has been changed in position and dimensions. Instead of being longitudinal it is transverse, so that the lenses do not close its extremities perpendicular to the axis, but are fixed in the middle of the curve, opposite each other, and parallel with the axis in question. This arrangement has permitted of placing in the interior a *diaphragm shutter* (Fig. 1).

This latter is a light cylinder containing two quadrangular apertures, and which, according to its position, arrests the luminous rays and performs the office of a shutter or partition. The rays are allowed to pass by, giving it a quarter turn, as far as the dimensions of the lens permits (Fig. 1 B).* The cylinder then performs the role of a diaphragm, to again become a shutter on continuing its movement and again making a quarter revolution.

During this rotary and semicircular movement, which is brought about by a spring and pawl, held by a ratchet, and which may be as quick or as slow as may be desired, the image is received and preserved on the sensitized plate.

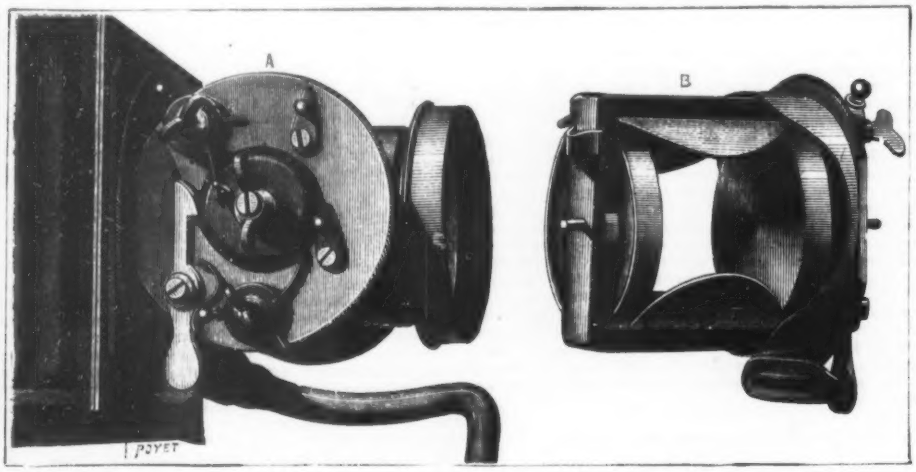


FIG. 1.—DR. CANDEZE'S DIAPHRAGM SHUTTER FOR INSTANTANEOUS PHOTOGRAPHY.

A, shutter ready for operation, showing the pawl acting on the spring. B, section of the apparatus, showing the two apertures in the cylinder in the position in which they allow the luminous rays to pass.

We may remark here that its rapidity is doubled by the movement of the apertures in the opposite direction. The peculiar form of these latter permits of illuminating the corners of the bromized plate longer than the middle, which naturally receives more light, and of distributing the action of the latter better.

The impressibility of the bromized gelatine, the use of which tends more and more to be substituted for that of collodion, is, so to speak, without limit. A hundredth of a second is sufficient for tracing an image. Thanks to it, it is possible at the present time to take photographs of trains in motion, persons jumping, birds flying, etc. The engravings annexed (Figs. 2 and 3) were made from proofs taken by me. In the first, a young man and a dog were taken at the moment they were jumping over a horizontal pole; and, in the second, there was taken a jumper at the moment at which he was going over the head of a comrade, after leaving a spring-board.

This leads me to say a few words about *motion* during photographic operations.

FIGS. 2 AND 3.—FACSIMILE OF INSTANTANEOUS PHOTOGRAPHS OBTAINED WITH DR. CANDEZE'S APPARATUS.

Formerly, when it required a pose of some duration for acting on the composition of silver salts, the most perfect immobility was prescribed both to the operator and sitter, even if the pose lasted but a second, under the penalty of obtaining on development only a blurred image. The perfect instantaneousness of the action of light resulting from that recent discovery of photography, the mixing of bromide of silver in gelatine, has resulted in diminishing the inconveniences due to motion. The more rapid the impression is, the less does immobility become necessary. In fact, a simple movement of the apparatus at the moment the shutter is acting does not cause any blurring of the image, at least none that is disagreeable to the eye. Now, if it is possible to photograph animate objects with an immovable apparatus, the converse is equally true. There is nothing to prevent the obtaining of a sharp image when the operation is performed in any vehicle whatever. I have several times performed an experiment which consisted in directing my apparatus from the window of a railway car in motion, and have always obtained satisfactory images of the landscapes spread out before me. It was simply a question of rapidity of execution. Certain conditions are indispensable, such as sufficient light, holding the apparatus in the hands without resting it on the vibrating edge of the window, and the choosing of subjects that are not too near, so as to fix in advance the focus per 100 meters or beyond. By a little practice these things may be readily learned by those who desire to make the experiment.

I will add, in conclusion, that the mechanism that I have described above may be removed from the box and replaced by a partition provided with diaphragms of different diameter, so as to operate them in the usual manner.—*Dr. Candèze, in La Nature.*

* This apparatus has been named the *gyrophragm*.

THE WESTERN UNION TELEGRAPH COMPANY.

DIRECTORY AND STAFF.

THE past and present success of a business enterprise, and its security for the future, are indicated always by the class of men directing its policy and employed in the administration of its affairs. If judged by this standard the Western Union Telegraph Company must take high rank. Its board of directors includes a larger number of wealthy and successful men than can be found at the council table of any other company in this country, or indeed in the world. It comprises twenty-nine members, and is most thoroughly representative of the varied financial and commercial interests of the country. Aside from the individual worth of these directors, estimated at from three to four hundred millions of dollars, they administer and control interests representing in the aggregate infinitely greater sums, employed in all the methods of transportation, and in every mercantile pursuit. In short, with a few exceptions, the directory is a body of magnates such as has never before been got together in the management of one enterprise.

In order that the reader, especially from abroad, may perfectly understand who these gentlemen are, their names are herewith inserted:

Norvin Green, President of the Company.
Thomas T. Eckert, Vice-President and General Manager.
John Van Horne, Vice-President of the Company.
John B. Van Every, Acting Vice-President and Auditor.
D. H. Bates, Assistant General Manager.
Edwin D. Morgan, ex-Governor State of New York, Capitalist and Merchant.
Augustus Schell, Capitalist and Director New York Central R. R. Company.
George B. Roberts, President Pennsylvania R. R. Co.
C. P. Huntington, President Central Pacific and Chesapeake and Ohio R. R. Cos.
Sidney Dillon, President Union Pacific R R Co.
Hugh J. Jewett, President of the Erie Railway.
Samuel Sloan, President Delaware and Lackawanna R. R. Co.
Jay Gould, Capitalist.
Russell Sage, Capitalist.
Alonzo B. Cornell, Governor State of New York.
Cyrus W. Field, Capitalist and Director Atlantic Cable Cos.
Edwards S. Sanford, Vice-President Adams Express Co.
James H. Banker, Capitalist.
Robert Lenox Kennedy, Vice-President Bank of Commerce.
J. Pierpont Morgan, Messrs. Drexel Morgan & Co.
F. L. Ames, Capitalist, Boston.
Harrison Durkee, Capitalist.
Edwin D. Worcester, Treasurer New York Central R.R. Co.
W. D. Bishop, ex-President New York, New Haven, and Hartford R. R. Co.
Zalmon G. Simmons, Capitalist, Kenosha, Wis.
Amasa Stone, Capitalist, Cleveland, Ohio.
George J. Gould, Capitalist.
Chauncey M. Depew, Director New York Central R. R. Co.
J. W. Glendinning, President Acadia Coal Co.
Erastus Wiman, President Great North-Western Telegraph Co. of Canada.

The staff of employés is an exceptionally strong one, owing largely to the fact that the rapid growth which has taken place in the business itself so rapidly within the past generation, has developed in the highest degree the capacity of the men engaged in carrying it forward. Thus, nearly every individual on the staff has had some peculiar training to fit him for the task in hand; while a majority of them engaged in the direct administration of its affairs have had an enlarged experience of the highest and most varied kind to qualify them for the positions they occupy. This is especially true of Dr. Norvin Green, the President, who has spent a lifetime in the most complete devotion to the advancement of telegraph interests, and whose wisdom and experience are well known and appreciated. Associated with the president is General Eckert, the able administrator of the details of the business. General Eckert was Assistant Secretary of War during the rebellion, and greatly distinguished himself by his ability and vigor in this important position at the most critical period in the history of our country. He is most ably seconded by Colonel Clowry, who is located at Chicago, and whose district comprises fully one-half of the entire continent. A corps of assistants and local managers, whose loyalty and confidence the general manager has won in a marked degree, supplement him at every point. The company is thus singularly fortunate in possessing the best administrative skill in every branch of its business, whether among its army of operators or in the financial, construction, or maintenance departments. While, on the one hand, it would be impossible to obliterate a staff and organization so complete for the purpose in view, it would on the other be equally impossible to duplicate it, even after long years of growth and experimenting, and at an expenditure such as no sane body of capitalists would for one instant contemplate.—*Review of the Telegraph and Telephone.*

ON LIGHTNING CONDUCTORS.

By M. MELSENS.

I PROPOSE to reply on a future occasion in a complete manner to the various objections raised against my system of lightning conductors. I will, in particular, discuss the opinion which sees danger in the use of a sort of cage formed of multiple conductors, among which some persons seem to fear the production of sparks of electrostatic induction. I will merely for the present recall an experiment which seems to me decisive, and which has been thus regarded by many physicists. This experiment supports those of Faraday, which prove that no electric manifestation is possible in a cage with continuous metallic sides, or of metallic network placed in perfect communication with one common reservoir.

Any small animal, such as a rabbit, etc., is placed in a hollow globe of metallic network placed upon the coating, or suspended from a powerful Leyden battery. The attempt was then made to strike the animal by the discharge. But far from being struck down the animal did not experience any action from a spark which would have been dangerous or even mortal but for the protection of the metallic cage.

The cage represents my lightning conductor, and the animal inclosed represents a house with its inhabitants and the combustible matter which it may contain. I remark further, that my conductor is fitted with numerous points, which certainly have not the property of provoking electric manifestations in the interior of a metallic cage, especially if it is in perfect connection with the moist earth, or with large metallic surfaces, or in a town with the water and gas pipes. —*Comptes Rendus.*

NEW PROCESS FOR THE RAPID FORMATION OF SECONDARY COUPLES WITH PLATES OF LEAD.

WE know that the method employed for a long time by M. Planté for forming accumulators consisted of a sort of electro-chemical tanning of the plates produced by the passage of the current into the couple several times in reversed directions, taking care to allow intervals of repose between each change of direction.

This method gives layers of peroxide of lead and of lead reduced to a crystalline state adhering perfectly to the remainder of the plate which is not attacked, but requires a tolerably long time, especially at the commencement.

To facilitate the attacking of the lead by the action of the primary current, and to accelerate the formation, M. Planté has made experiments and discovered that good results can be obtained by raising the temperature of the liquid containing the secondary couples, sometimes beforehand, sometimes during the action of the current.

The employment of heat presents, however, some difficulties in practice. M. Planté has had recourse in this case to another process which has given him very satisfactory results, and which he has communicated to the Académie des Sciences of Paris at its sitting on the 28th August last.

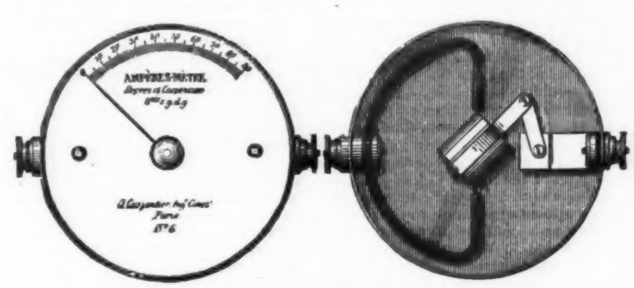
This process consists of simply submitting the secondary couples to a sort of thorough scraping by means of nitric acid diluted with half its volume of water, and leaving them immersed in this liquid during twenty-four or forty-eight hours. The couples are then emptied, washed very thoroughly, refilled with water acidulated with one-tenth of sulphuric acid, and submitted to the action of the primary current. This prolonged immersion in diluted nitric acid produces a dissolution of a portion of the lead plates, but their thickness is not sensibly diminished by it. The metallic porosity produced by the nitric acid causes the ulterior electro-chemical action of the current to be exercised not only on the surface of the plates, but also on their interior;

it creates new molecular intervals, and consequently facilitates the formation of the plates, considerably shortening its duration. In fact, the secondary couples thus treated can furnish, after three or four changes in the direction of the primary current, discharges of long duration, while without the previous action of the nitric acid, it could only give the same results after several months' formation.

Accumulators prepared by this method seem, therefore, to present at once the advantages of couples of lead plates; that is to say, a good adherence of the deposits and the absence of the felt which maintains the minium upon the plates of the Faure couples, and at the same time the advantage peculiar hitherto to the Faure couples; that is to say, a rapid formation—a condition indispensable with accumulators intended for industrial application. It would be interesting to make new and careful comparisons between the last models of M. Faure and the new apparatus of rapid formation of M. Planté, as much from the point of view of rapidity of formation as of capacity of storage and of their effective duration in continual service.

DEPREZ & CARPENTIER'S VOLTMETER AND AMPEREMETER.

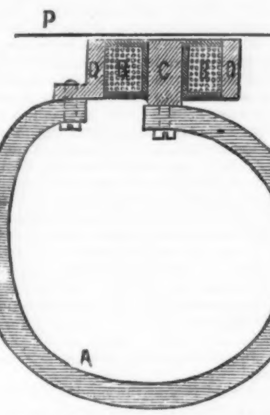
INDUSTRIAL needs are, as regards electric measurements especially, very different from those of science. An apparatus placed in a workshop, to be put into the hands of every one, should, before everything else, be simple, plain, and of low price. Its exactness has no need of reaching the fifth decimal, and, in most cases, it is only necessary that it shall give, to near a unit, the extent of the quantities to be measured. It is with such an idea in view that have been constructed Messrs. Deprez & Carpentier's *voltmeter* and *amperemeter*. The first of these indicates the difference of potential between the two points of a circuit, and is branched on to a *derived circuit;* while the second indicates the intensity of the current, and is placed on the circuit itself. The two apparatus differ only in the size of the wire of the bobbin, which is formed of very fine wire in the voltmeter and very coarse in the amperemeter. The modification introduced into Deprez's galvanometer by Mr. Carpentier consists in placing the bobbin *obliquely* in the magnetic field formed by the directing magnet of the needle. The deviation of the galvanometric helix has the effect of doubling the graduation and the angle of deviation in one direction for a given intensity, and of annulling it in another. It is necessary, then, that the current shall always traverse the apparatus in the same direction in order to deviate the index in the direction of the hands of a watch, when the apparatus is examined on the side that carries the graduated face. The index is formed of a simple horse-hair, and the whole apparatus is inclosed in a round brass case 8 to 10 centimeters in diameter, thus giving it externally the appearance of an aneroid barometer. With two of these apparatus fixed on a machine, it is easy to follow the variations in electromotive force and in the intensity of the current, and to deduce therefrom the electric energy expended in the external circuit. As the apparatus is asymmetrical, the deviations are not accurately proportional to the intensities in the amperemeter, or to the electromotive forces in the voltmeter; but this defect is corrected by the use of a reduction table that accompanies each apparatus, and the advantage is preserved of having a wider and consequently a more precise graduation that permits of very easily estimating the semi-empere or semi-volt, an approximation quite sufficient in practice. The accompanying figure, which gives a top and bottom view of the apparatus (the bottom of the case removed), will give a very good idea of its very simple arrangements.—*L'Electricien.*



DEPREZ & CARPENTIER'S AMPEREMETER.

M. A. D'ARSONVAL'S TELEPHONE, WITH CIRCULAR MAGNETIC FIELD.

THIS new form of magnetic telephone was presented by the inventor at the sitting of the French Physical Society on the 21st of July. M. d'Arsonval was led to adopt this arrangement by studying the effect produced by a wire traversed by an electric current on a double pole telephone (of the Gower, Siemens, or Ader type), without coils. Placing the wire in every position between the poles, internally, laterally, etc., he found, as might be expected, that the maximum of effect is obtained when the wire is in that position where the magnetic field is greatest, *i. e.*, between the two poles of the magnet. It is in order to increase the useful part of the wire, which is placed between the arms of the magnet, that the Gower and Ader telephones are furnished with flattened poles. M. d'Arsonval asked himself whether, with a suitable method of coiling, it would not be possible to suppress entirely the outer part of the wire, which introduces into the circuit a supplementary resistance without much useful effect of importance. He effected this by constructing a telephone with circular magnetic field, similar to Nickles' electromagnets. The apparatus shown in the accompanying diagram resembles in its outward form an Ader telephone. The bent magnet, A, forms a handle; on one of the poles is fixed a cylindrical core, C, of soft iron, on the other a ring of soft iron, D, inclosing the first; the coil, B, is placed in the annular space which is left free between these two circular poles. The magnetic field is thus concentrated into the space occupied by the coil, and the lines of force are turned into a direction perpendicular to the wire of the coil. When the telephone is employed as a transmitter, the movements of the plate, P, produce a sort of pivoting of the lines of force, which gives rise to induction currents. When the telephone is employed as a receiver the undulatory currents which traverse the coil produce a maximum of effect, since they act in that part where the magnetic field is most intense; the modification which they bring to bear on the continuation of the lines of force react upon the plate and make it vibrate. With much less weight and a much shorter wire—M. d'Arsonval's telephone weighs 125 grammes, and has only 20 ohms of resistance—we obtain effects as powerful as those produced by the Gower telephone, but with more clearness.



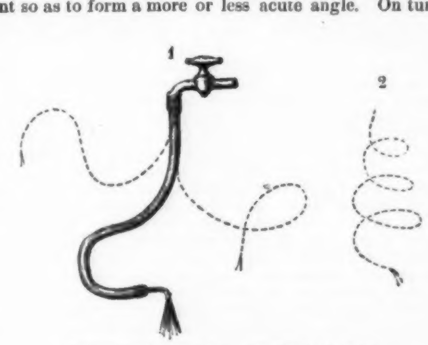
D'ARSONVAL'S TELEPHONE.

The Gower telephone being furnished with an ear-piece, produces a sound like that heard in a sea-shell, which M. d'Arsonval attributes partly to the too great diameter of the tube, and partly to the spiral of metallic wire placed in the tube in order to prevent its becoming flattened. M. d'Arsonval has obviated this difficulty by using a simple tube of gutta percha eight millimeters (one third of an inch) in diameter, and thus all resonance is destroyed. It is advantageous in practice to arrange a double tube, one for speaking, and the other for hearing.

AN EXPERIMENT IN HYDRAULICS.

A FRENCH professor of physics sends to our contemporary, *La Nature*, the following description of a simple experiment, which may be added to those already published in previous numbers of this journal under the caption of "Physics without Apparatus."

A piece of rubber tubing (it is better that it should be old, so as to be quite flexible) is adapted to a water faucet, and to its free extremity there is affixed a glass tube which is bent so as to form a more or less acute angle. On turning on the faucet the reaction of the water on the tubing displaces it; but, owing to the elasticity of the rubber the direction of the force changes very rapidly, so as to cause the tubing to undergo the strangest and most varied motions, some of which are shown in the dotted lines in the annexed cut. If the rubber employed is very thin the motions become still more complicated; and, in this case, it is not necessary to employ the glass tube at the extremity of the rubber tubing, provided the pressure of water be properly regulated.



EXPERIMENT IN HYDRAULICS.

ELECTRO-METALLURGIC PROCESS OF MM. BLAS AND MIEST.

THE authors have established the novel fact that if in electrolysis we replace the metal of the anode by sulphureted ores in a state of compression, the latter may serve themselves as anodes. Further, if we place such anodes in a bath of a suitable electrolytic salt, of the same metallic base as the metal of the ore, and let the electric current act in the bath, the result is that all the sulphur of the ore is precipitated upon the anode, and falls from thence to the bottom of the bath. In the meantime there is formed upon the cathode a deposit or precipitate of metal liberated from the salt, which forms the electrolytic bath. On the other hand, the acid of the bath, in proportion as it is set free, appropriates an equivalent proportion of the metal contained in the ore placed at the anode. In this manner the neutral electrolytic bath is reconstituted without ceasing and serves indefinitely.

ON THE USE OF CERTAIN INSTRUMENTS IN THE TREATMENT OF SKIN DISEASES.*

By GEORGE HENRY FOX, M.D.

THE treatment of skin diseases was formerly considered to lie within the domain of surgery, and external measures were chiefly relied upon for their cure. It is only within recent years that the internal origin of many skin diseases has become thoroughly appreciated, and to-day dermatology is justly considered to be simply a branch of general medicine. There are certain diseases, however, which require surgical treatment, and to these and a few simple instruments which are commonly employed by dermatologists I will invite your attention to-day. Of cancer in its various forms, and other malignant affections involving the skin and requiring removal with the knife, I will not speak, since these naturally come under the notice of the surgeon. There are certain special instruments, however, which are solely used in the treatment of skin affections which it may be well for you to possess, and which, I hope, you will have frequent occasion to use.

The first and simplest of these is a short silver tube, with a caliber about the size of a fine knitting needle, which I term the comedo-presser or extractor. The end of this should be carefully rounded so that it will not scratch or otherwise injure the skin. In many cases of comedo, occurring alone or associated with acne, this little instrument will be found to be almost indispensable. You know it is a very common custom for patients suffering from acne to press out the little black-heads, as they are termed, either by means of the thumb-nail or an ordinary watch-key. The watch-key commonly answers the purpose; but, as the hole is square instead of round, and the end is often rough, delicate skins are not infrequently caused to suffer from its use. A number of small instruments have been suggested as substitutes for the watch-key, but a silver tube I have found to be of the greatest value.

We have before us a young woman with pustular acne. Interspersed among the small papules and pustules are numerous projecting black specks which you will recognize as comedos or comedones. As inflammation of the sebaceous glands, which is the essence of acne, is very apt to be excited by the presence of this inspissated sebum in the ducts of the glands, one of the first steps in the treatment of this case will be to remove these fatty plugs; by carefully applying the end of the tube over the black dot and giving it a quick, sharp pressure, the comedo is expressed from the duct with the greatest of ease and commonly with no pain. It is not a pleasant operation, to be sure, and you will find some patients who will wince under this treatment. When the comedos are very dry and hard, it may be found advisable to have the patient steam the face before using the instrument. This can easily be done by placing the patient's face over a vessel of boiling water for a few minutes, the head being covered by a towel. There is always a tendency for the ducts to refill after evacuation; but if the skin is stimulated by the daily use of soap, the glands will soon resume their natural action. You will notice that the use of this instrument produces a small red spot wherever it has been applied, showing that the skin is in an irritable condition. In some cases you will find the skin so irritable that this simple operation of pressing out the comedo will produce a small whitish lump or wheal similar to that which follows the bite of a mosquito. Where this irritability of the skin exists in a case of acne, you may depend upon it that there is dyspepsia or some underlying condition which aggravates the acne, and it will be impossible to effect a cure without resorting to internal treatment.

This patient tells us that the pustules occur in successive crops, and that they are specially apt to appear during the week preceding her menstruation. Most of the pustules run a rapid course and disappear in a few days or in a week's time. Occasionally deep-seated pustules are formed which do not tend to spontaneous evacuation, but produce nodules which remain for several weeks, or even longer. These give rise to a little pain at first, but soon form firm, painless tumors. The patient is often tempted to prick these large pustules with a needle, which, however, has no beneficial effect. To secure their speedy removal it is necessary to treat them as small dermic abscesses and to open them freely.

The next instrument to which I call your attention is one which is adapted to this purpose. It is, you see, a small spear-shaped lancet, with a shoulder upon either side, which prevents the point from going too far into the subcutaneous tissue. If with this instrument we merely puncture the true skin, a drop or two of blood is caused to flow and the lump remains. If, however, we press it into the nodule until the shoulder reaches the surface of the skin, we generally succeed in evacuating a little pus or a small amount of cheesy matter. The wound will heal quickly under these circumstances, and the indurated nodule will be found to have disappeared. In the treatment of all cases of acne indurata a more rapid improvement can be obtained by the use of this acne lance than by any other method of treatment.

The next instrument which I show you is a small kidney-shaped knife or lancet which is used for the purpose of scarification. This instrument varies in its form, and some prefer to use a multiple scarificator, consisting of ten or twelve knives placed side by side, about a millimeter apart. A single blade, however, I think, will usually answer the purpose of scarification; and after a little experience, the parallel cuts may be made very close to each other. This instrument has been recommended for use in a number of skin affections; but the one in which I have found it most serviceable is the tubercular or ulcerated form of lupus, especially when this affects the nose or a part in which loss of tissue is extremely undesirable. The parallel incisions create an amount of inflammation which tends to destroy the morbid cells, and to leave the healthy tissue unimpaired, which would not be the case were a caustic employed for this purpose. In a case of lupus of the cheek, the dermal curette, of which I shall presently speak, or any form of caustic, can usually be employed to advantage, and a smooth scar obtained; but when lupus affects the wings of the nose, as it is very prone to do, our object should not be simply to destroy the morbid growth but to do this with the least possible destruction of the healthy tissue. In such a case the results of scarification have proved astonishing, and a nose which seemed almost certain to be wholly or in part destroyed, has healed with a very slight amount of deformity. To use this instrument properly requires a steady and skillful hand and a certain amount of experience. The parallel incisions should be made as close to each other

* A clinical lecture, by George Henry Fox, M.D., Clinical Professor of Diseases of the Skin in the College of Physicians and Surgeons, New York.

as possible. The hemorrhage which results can be readily checked by the use of absorbent cotton or a small piece of blotting paper. The cuts heal in a few days, when scarification may be again practiced, the incisions this time being transverse to those first made. In a bad case of ulcerated lupus of the nose, this treatment should be repeated once or twice a week for several months. Under this plan of treatment, the ulceration will assume a healthy character and heal. The morbid growth will gradually disappear, and the final result, though not quickly attained, will prove most satisfactory to both physician and patient. In certain cases of rosacea, scarification may be also employed with advantage. The parallel incisions will usually destroy the fine superficial vessels. Where the nose is considerably enlarged, however, and the cutaneous vessels are very much dilated, the treatment by scarification will generally prove of little service as compared with other methods.

Some of you may be aware that, a few years ago, an English surgeon advocated the use of linear scarification for the removal of superficial vascular nævus or wine-mark. This plan of treatment, however, apparently failed in the hands of all who tried it, save its originator, and has now been generally abandoned. I shall presently speak of a plan of treatment which, in my experience, bids fair to be the only successful method of dealing with this common and disfiguring affection.

Now let me call your attention to one of the most useful instruments in the surgical treatment of lupus and epithelioma, and one which has been recommended in the treatment of acne, sycosis psoriasis, and other skin affections. This instrument is the dermal curette—the sharp spoon of the Germans. As you see, it is a small, stout, spoon-shaped instrument, perforated by a circular hole, and resembling the bonescraper used by surgeons. The instrument may vary a great deal in size and shape, but its purpose is to gouge or dig out of the skin certain morbid growths which are found to be much softer than the normal tissues, however dense or indurated they may feel to the touch of the finger.

The cases of lupus and epithelioma which were formerly allowed to increase in size under inefficient modes of treatment, or submitted to the surgeon for complete excision by means of the knife, are now commonly removed by the use of this instrument.

Our next patient has, as you will perceive, even at a distance, a flattened growth upon the forehead, with a depressed, slightly ulcerated center, and an elevated waxy margin. This is a case of superficial epithelioma, or rodent ulcer, as it is commonly termed in England. It began six years ago as a small excrescence like a wart. It bled when scratched, and has steadily but slowly increased in size. It is painless, and in its present location would not prove serious if allowed to remain for several years more. At the same time, the patient is desirous of having it removed, and the sooner a growth of this kind is destroyed, the less disfiguring will be the resulting cicatrix. The first and principal point of treatment is to destroy thoroughly the morbid growth. This can be accomplished equally well by the knife, the curette, or by caustics of various kinds. Its removal by the curette is the simplest, quickest, and least painful method which we can adopt. A second point of treatment is to remove all the growth with the least possible destruction of healthy skin. With the curette this can easily be accomplished. Although it feels indurated and harder than the surrounding skin, we will find that this outgrowth will yield readily to the scraping which we are about to employ, while, on the other hand, it would be an extremely difficult matter to dig into the healthy fibrous corium by means of this comparatively dull instrument. The operation is not attended by much pain, and I am sure the patient can stand it without the use of an anæsthetic. You now see how readily the indurated mass can be scraped away, how slight the hemorrhage is, and how quickly we have succeeded in converting the seat of the growth into a patch of raw skin. It is possible now that we have not entirely destroyed all of the diseased cells. To make certain that there shall be no return of the growth, it will be advisable either to cauterize the raw surface, which would give the patient quite as much or more pain than the scraping, or to apply iodoform and tightly bind it upon the raw surface. The application of iodoform, which has been lately recommended in the treatment of lupus, is painless and extremely efficacious in destroying any morbid cells which may remain. It promotes a rapid cicatrization on the ulceration. We will powder the surface thickly with iodoform, cover this with a layer of absorbent cotton, and hold this tightly in place by painting it over several times with flexible collodion. Beneath this dressing the ulcer will probably heal in a fortnight, and possibly without suppuration. The tubercular patches of lupus vulgaris may be successfully treated in a similar way. In Germany, the use of the curette is recommended for the treatment of acne, and I have used it successfully in one or two cases of pustular acne of unusual severity, scraping the pustules and papules relentlessly at intervals of from three to five or eight days. It is only in the severest form of acne that such a harsh plan of treatment, however, would be advisable. To treat the ordinary cases of acne which will come to you in private practice by means of the dermal curette would prove to be the quickest possible means of reducing the number of your patients.

Removal of Hair by Electricity.—Another important instrument for dermatological purposes, and the last one of which I shall speak, is the electrolytic needle. The use of this implies the possession of a galvanic battery, an instrument which you will doubtless have on hand for other purposes, and the number of affections in which it can be advantageously used is constantly increasing. One of the most important recent advances in dermatology is the operation for the removal of superfluous hair, the development of which reflects no little credit on American dermatology. Until recently ladies afflicted with an unwelcome growth of hair upon the face have sought relief in vain. You may now assure all such who may apply to you for advice that the growth can be readily removed.

I will now bring before you a patient with a few stiff hairs growing from a small mole upon her chin. By destroying them I will best demonstrate the method by which a moustache or beard can be permanently removed. Connected with the negative cord of a battery I have attached a fine flexible steel needle, which I carefully insert into the follicle by the side of one of these stiff hairs. Grasping the hair with the forceps held in the left hand, I will now ask my assistant to complete the circuit by applying the sponged-tipped positive electrode to the patient's cheek. Electrolytic action is now manifested around the needle by the blanching of the tissue and slight frothing, which those of you who are near will readily observe. I now make gentle traction upon the hair, which, after the lapse of a few seconds, readily comes away, showing that the hair papilla or matrix of the hair, if I may use the expression, has been destroyed. Pulling out the hairs, or removing them by means of depilatories, is simply a palliative measure. The procedure which you have now witnessed is followed by the complete and permanent absence of hair. The ordinary cambric needles will answer the purpose, although they are more likely to leave a slight pit than the fine needle which I have employed. This operation is a tedious one, and often quite as tiring to the operator as to the patient. The hairs must be destroyed one at a time, and where there are thousands to be removed, as has been the case in several patients on whom I have operated, a considerable amount of time and patience is requisite. To my friend, Dr. Hardaway, of St. Louis, is due the credit of introducing this operation into dermatological practice.

I have already spoken of the treatment of wine-mark by scarification, and called your attention to the disappointment caused by its lack of success in my hands as in many others. I have recently employed electrolysis in the treatment of one or two cases, and succeeded in transforming a dark and unsightly purplish patch into a light pink and far less disfiguring mark. I am not yet prepared to state that wine-mark can be treated by electrolysis with a degree of success equal to that which has attended its use in the destruction of hair, but by the production of numerous minute cicatrices it is easy to improve greatly the appearance of a wine-mark; and by further experimentation with this method, I trust that the complete removal of such a mark will eventually be achieved.

Having demonstrated to you the methods by which superfluous hair may be removed from the face, an operation which is now thoroughly established, and explained to you the somewhat similar method of treating the superficial vascular nævus, an operation which is comparatively new, it remains for me to speak briefly of the value of the electrolytic needle in the removal of certain facial blemishes of lesser importance.

Telangiectasis.—We will begin with that dilated condition of the capillary vessels which is known as telangiectasis. This affection presents itself in a variety of forms; the most common is that which is seen upon the wings of the nose, either alone or in connection with rosacea. The dilated vessels may be of a bright red hue, or they may appear purplish and tortuous, as in the swollen nose of the drunkard. In either case they are unsightly and call for local treatment. Heretofore this has consisted in slitting up the vessel and applying nitrate of silver or perchloride of iron. More recently multiple puncture or scarification has been employed, but by far the simplest and most effective method of treatment is that recommended by Dr. Hardaway, viz., the use of the electrolytic needle. With a fine and sharp needle, connected with the negative pole of the battery, the dilated vessel is pricked at the point where it appears to emerge from the corium and make its appearance upon the surface of the skin. The circuit being now completed by touching the sponge-tipped positive electrode to the cheek, hand, or any portion of the body, the characteristic blanching is quickly observed around the needle, and in a few seconds the vessel has become white for a short distance from the needle. The object of the operation is to excite enough inflammation at a given point to cut and ligate the vessels as it were, and the number of seconds required to accomplish this end will depend upon the strength of the current, and the distance between the electrodes. Here is a well-marked case of rosacea in a man who is evidently not an advocate of total abstinence—in practice, at least. You see the swollen and tortuous venules upon the sides of the nose, slightly elevated above the level of the skin. In this case we will use twelve cells of a zinc-carbon battery, and apply the sponge to the patient's cheek. You now see the chemical action taking place in the tissue around the needle, and those of you who are near enough can see the bubbles of hydrogen coursing through the vessel and its branches, like the blood corpuscles seen beneath the microscope in the web of a frog's foot. To destroy all of these vessels upon the side of the nose, it is necessary to introduce the needle repeatedly, and allow it to remain each time from five to ten seconds.

In this next patient, a young woman who has come to the clinic on account of another skin affection, you notice upon the cheek a small, bright-red point from which a few fine tortuous vessels radiate. Its spider-like form has given to this affection the name of *nævus araneus*. The patient states that the spot made its appearance a few years ago without any known cause. Very likely it resulted from the prick of a pin or some other trifling injury. It manifests no tendency to increase in size, and gives the patient no annoyance, but still she is willing, and even anxious, to have it removed, if this can be done without much pain. I now insert the point of the needle in the center of the red spot, which naturally occasions a slight pricking sensation. The patient will now grasp the moistened sponge connected with the positive cord of the battery, and she now undoubtedly experiences a sharp, stinging sensation, which is by no means agreeable, although it is not particularly painful. You see that the redness has already disappeared, and in about a minute or two, having now removed the needle, a slight swelling will take place similar to that which usually follows a mosquito bite upon a delicate skin. The result will be a destruction of the blood-vessels and a fine punctate cicatrix, which will be unobservable except upon the closest inspection.

Angioma.—In one or two patients who have been partially stripped in the clinic, I have called your attention to the existence of numerous little vascular tumors of the size of a pinhead or lentil, and projecting slightly above the surface of the skin. These small angiomata are of no consequence when situated upon the body, but when, as occasionally happens, they occur upon the face, it is a very easy matter to destroy them by this simple operation.

When they are as large as a small pea, it is advisable to introduce two needles, one connected with either cord of the battery, and have their points almost touch. Angiomata of larger size (the vascular nævus described in works on surgery) can usually be successfully treated by introducing two or more gold-plated needles of larger size. A preferable plan of treatment for these vascular growths, however, and one which I hope soon to have the oportunity of demonstrating, is the application of the ethylate of sodium.

Nævus Pigmentosus.—Let me call your attention now to another trifling affection of the skin, which is so common that it may be found upon the skin of a large minority, if not the majority, of healthy persons. I refer to the little pigmented spots which, like permanent freckles, are so often found upon the face, the backs of the hands, and upon covered portions of the body. They are either congenital or develop in early life, and in persons of a dark complexion they may be very numerous. Usually they are not much larger than a pin's head. I will pass around the photograph of a man who had an unusual number of these small pigmentary nævi upon his arms and body. I remember this patient telling me that, although the spots never disappeared, they were much darker in summer than in winter, even upon the covered portions of the body. Such spots when not elevated above the surface of the skin occasion no annoyance whatever, except when they happen to occur upon a lady's face. Treatment now becomes an important matter, and again electrolysis comes in play. It is not necessary to insert the needle into the deeper portion of the skin, for you will remember that the pigmentary deposit is situated in the cells of the epidermis just above the papillary layer of the true skin. All that is necessary is to produce a small blister upon the surface of the black spot, and by touching it repeatedly with the point of the needle, we can accomplish this end as readily as by the application of a caustic, and with less likelihood of leaving a noticeable scar. For pigmentary nævi of large size, I will not recommend the electrolytic needle, as I have had no experience in its use in such cases.

Fibroma Simplex.—Upon the cheek of our next patient, a woman of forty-five, you see a little excrescence of the size of a small pea. Such a growth is commonly spoken of as a "wart" or a "mole." Frequently it is pigmented, and the seat of a few stiff hairs, and is called *nævus verrucosus*. The growth in this case is of firm consistence, with a smooth surface, and slightly redder than the surrounding skin. It is simply a hypertrophic growth of the fibrous tissue of the corium, and constitutes a blemish which is very frequently seen upon the face of persons of middle and advanced age. Its removal is by no means imperative, and the fear expressed by our patient, that it is likely "to turn into a cancer," is unfounded. There are ladies who affect to regard an unsightly excrescence of this kind as "a thing of beauty," but you will find that when they learn that it can be removed with very little pain, and without the use of a knife, they will be very willing to part with it. In this case we will use fifteen cells of our constant current battery, and transfix the growth with the needle upon a level with the surrounding skin. You now see that the growth is turning white from the action of the current, and that the needle can be moved forward and backward with perfect ease. We will now transfix the growth again, the needle being at right angles to its former direction, and allow the electrolytic action to proceed as before for about ten seconds. What will be the result? For about twenty-four hours the growth will be slightly swollen and inflamed, and although it is not necessary, it may be advisable for the patient to keep a hot fomentation over the part. In a few days the growth will shrivel away, possibly forming a minute crust or slough, and in a few weeks there will be nothing but a slight cicatrix to denote the site of the operation.

In the cases of multiple fibromata, which occur upon the body and extremities, the tumors are usually too large for this treatment, and they should be removed, if it is deemed necessary, by the knife or galvano-cautery.

Xanthoma.—Another facial blemish, which you may be called upon to treat, is the affection which is known as xanthoma or xanthelasma. This appears usually in the form of oval yellow patches upon the upper eyelids near the inner canthus of the eye. One or both upper lids may be affected, and in some cases fainter yellowish patches are noticed beneath the eye. Patients affected with xanthoma are apt to have hepatic derangement, and to present a sallow complexion, with dark rings around the eyes. The principal, if not the only, treatment which has been employed in these cases is excision, a remedy which, in the estimation of many patients, is worse than the disease. In the case of a lady who recently applied to me for treatment of xanthoma, and who was averse to any cutting procedure, I resorted to the use of the electrolytic needle, and succeeded in removing the growth. I will not presume to recommend this plan of treatment on the strength of my limited experience, but I shall certainly adopt it in the next case with which I have to deal.

There are some other cutaneous affections in which the electrolytic needle might be employed to advantage, but what I have already said will give you an idea of its value and extended application. It acts like a caustic in destroying the cutaneous tissue, but is more efficient in many respects and under our control to a far greater degree than any ordinary caustic which could be used. It is not a true caustic in an etymological sense, for it destroys tissue by chemical action, and not by the generation of heat as in the platinum wire connected with a galvano-caustic battery. And now, before closing, let me say a few words in answer to questions which might otherwise be asked respecting the character of the battery employed for the purpose of electrolysis, and the number of cells which it is necessary to use. It seems almost superfluous to say that the battery should be of the kind which is known as the galvanic or constant current battery, and yet I have known physicians to attempt the use of electrolysis with a Faradaic battery—*i. e.*, one with an interrupted current, which is wholly unsuited to the purpose. The galvano-caustic battery, though producing a constant current, is constructed for the sole purpose of heating a platinum wire, and is equally unsuited for electrolysis. There are a variety of galvanic batteries with different elements, any one of which will answer the purpose of electrolysis, but the ordinary zinc-carbon battery is the one commonly employed. I have used here in the clinic a chloride of silver battery with cells hermetically sealed, and which is therefore adapted to being carried about. It can be tipped over without any danger of ruining a carpet by spilling the contained fluid, but it is an expensive battery, and one very liable to get out of order, and hence not to be recommended for general use. The battery which has given me the most satisfaction is the zinc-carbon battery, manufactured by the Electro-Medical Manufacturing Company, of this city. It possesses electromotive force in a high degree, is very simple in construction, not liable to get out of order, and easily repaired when this becomes necessary. It is constructed with a varying number of cells, but the twenty-cell battery is the size which I should recommend for use in the treatment of the affections of which I have spoken. This battery is so constructed that if a few of the cells are exhausted the remaining ones can still be used. In the operations to which I have referred, from ten to fifteen cells may be required. If the battery fluid is fresh, the sponge in connection with the positive electrode well moistened, and applied to the skin as near as possible to the needle, the current will be at its maximum strength, and a smaller number of cells required than when the battery fluid is weakened by use, the sponge dry, or nearly so, or when the circuit is completed, by placing the positive electrode in the patient's hand, and the resistance to the current thereby increased. These points being borne in mind, a sufficient number of cells should be employed to produce the desired effect—viz.,

a gradual dissolution of the cutaneous tissue at the point where the needle is inserted. It is always advisable to introduce the needle before completing the circuit, and to break the circuit before withdrawing the needle. By observing this rule an unpleasant shock may be avoided.—*Medical News.*

SUDATORIES AT THE HEISER MEDICAL GYMNASIUM.

THE accompanying engravings show the arrangement of the sudatories employed in the Heiser Medical Gymnasium at Paris, which are especially designed for the treatment of gouty, rheumatic, and cutaneous affections, and certain maladies of the organs of respiration. These apparatus, which are got up under the best of conditions for giving comfort to those who use them, permit of taking steam or hot air baths, and of procuring those artificial sudorific effects that are recommended by physicians in a large number of cases.

CRATERS OF THE MOON.

THOSE parts of the moon's surface that commonly receive the name of *craters*, the numerous circular forms inclosing a depression, in which mostly rises a group of hills, have no great similarity to the volcanoes of our earth. On the other hand, lunar formations have been described in recent times which, in the opinion of selenographers, are the analogues of terrestrial volcanoes. In this class Herr Klein (in a recent paper, of which an abstract appears in the *English Mechanic*, translated from *Der Naturforscher*), reckons in the first place the so-called *crater cones* of Mr. Neison to belong. These are steep or conical hills, or mountain summits, varying in diameter from ½ to 2 or 3 miles, with steep, funnel-like, central depressions, scarcely half as large, which, with a high sun, appear in strong telescopes as very small white spots; they occur sometimes on the top of a mountain, but not infrequently also on the inner surface of a circular range, or a walled plain.

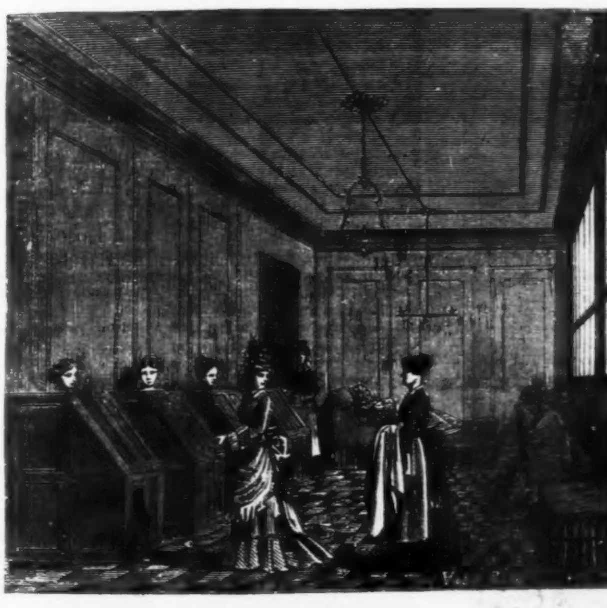
Another class of formations of the moon's surface, which seem to Herr Klein in a still higher degree to resemble our volcanic formations, have previously been observed only by Herr Schmidt in Athens, who described small dark spots as imperfect half-shaded craters, and in them a white central part, which appears at times as a crater. These forms are so rare that Herr Klein can only count five which present this type with certainty, and two in which it is probably present.

Herr Klein, without knowing of Herr Schmidt's observations, has himself found two of these formations in the neighborhood of Theophilus, and regarded them as craters with bright white crater cavities, which are surrounded to a great distance with a ring of gray matter. The larger of the two craters appeared on further observations as a flat cone, on the outer portion of which (extending several miles) the steep eruption-cone stands at the highest point; the dark gray mass was only in the neighborhood of the white main crater, bedded round about its steep cone (on the slope Herr Klein observed some small secondary craters). The second crater showed similar features; but since last autumn it has not been so distinct as before, and one sees now only a gray spot within a dark ring. A similar object was discovered fifty years ago by Gruithuisen, south from Hyginus; he saw a small, bright, white crater in the middle of a gray broad spot. This small crater is still present; but Herr Klein has never seen it as a bright spot, nor has Herr Schmidt. Now, since Gruithuisen's observations are beyond question, it is to be inferred (Herr Klein says) that that small crater has darkened in the course of years. "From the agreement in the cases mentioned, but especially also from very careful examinations of the large crater in the southwest of Theophilus, it may be concluded that the dark matter which surrounds the brightly shining crater was thrown out from this. We may regard it as a kind of lava which, in time, fades." That the formation of the ring of dark matter, or the "eruption" southwest of Theophilus, belongs to recent time, Herr Klein infers from the circumstance that this dark spot, which is very obvious, and even appears on one of Rutherfurd's lunar photographs, was seen neither by Lohrmann, Mädler, nor Gruithuisen.

The intimate connection between the dark matter and the bright crater at its middle, as also the inference that this mass was thrown out, lava-like, from the crater at a time long after its formation, Herr Klein has been able to establish by several years' study of such a lunar crater observed by no one previously. The object in question lies in the interior of the great walled plain Alphonsus, where Mädler has described a triangular dark spot, remarkable in full moon for its darkness and regularity. Within this spot Herr Klein has discovered the bright crater cone, and he has closely studied it. He gives a small map, showing the position of this cone and its surroundings. From observation with different solar altitudes, it appears that in the neighborhood of the crater-cone small hill ranges and undulations are present, and as one can still at the same time perceive the double triangle in them, a distinct conviction is reached that the dark material has everywhere spread to the lower positions, and has thereby acquired the characteristic form of the triangle. This material, however, can only have accumulated in a comparatively thin layer, which could not cover even small elevations, for even the small hillocks appear, with a certain solar altitude, as fine light points projecting from the dark triangular surface. Thereby is also proved that the dark material did not fall from above like volcanic ashes, and cover everything; but that it was liquid, as it spread outward.

"In my opinion," says Herr Klein, "the relations here depicted prove the existence of phenomena on the moon's surface which present the greatest similarity to the lava-floor of our terrestrial volcanoes, so that the occurrence of true volcanic phenomena on the moon is no longer to be doubted. These phenomena belong, in the case of the crater described, to an epoch when the hill-ranges of the surrounding surface were already present, so that the outflowing material had to follow the inclines presented by the ground.

"While in the example just given, all the phenomena point to lava-like flows, we may in another case, though with less certainty, infer the covering of the ground with stone or ashy masses. The region in question lies at 1° N. lat., and 47° W. long. There the gray bottom of the shallow sea, studded only with very low hills, is traversed with bright streaks of light. One observes, however, even with a low sun, that on a surface of several square miles, an egg-shaped spot, as of dark gauze, covers the ground, and below it the brighter and darker parts of the ground glimmer out. This spot gives an observer the impression of its being transparent, or of a fine mist covering the ground. The latter, however, cannot be accepted; for the spot is a quite persistent phenomenon, a modification of the color of the moon's ground. But such would necessarily arise if the ground, both where it is bright gray and where it is crossed with white streaks, were covered with ashy or stony masses in very thin layers. Similar indications are found in other places on the moon's surface; but they have mostly escaped moon-observers hitherto, because these considered the more general and large features of the lunar surface, and the investigation of details has properly only begun. Thereby, already, a much greater similarity of the moon's surface to that of our earth than was formerly supposed, has been made out. Still the investigation is only beginning, and is in presence of quite infinite detail; besides this, it is much more difficult and trying than many other observations."



SUDATORY HALL FOR LADIES. (Heiser Gymnasium.)

SUDATORY HALL FOR GENTLEMEN. (Heiser Gymnasium.)

THE CYCLONE AT BROWNSVILLE, MO., APRIL 18, 1882.

By W. H. WILLIAMS.

THE terrible agent of destruction which visited Brownsville on the afternoon of the memorable day above named, was, perhaps, in some respects, the most peculiar of any one of its kind ever seen or felt by the people in this latitude.

During the entire day clouds were seen in all directions in the sky; but they were only light, fragmentary ones, the feathery appearance of which did not attract more than a glance. It was not until 3:45 that the overcast of the heavens began to signal the approach of a storm of great violence.

At that hour the whole surrounding atmosphere began to assume a dull, heavy color, and then change to an orange tint, very unnatural and peculiar. For a few moments all objects appeared as if seen through stained glass. Toward the southwest a very dark, heavy, green looking cloud was seen rising just above the tree tops. This cloud was compact in shape, solid in surface, and seemed to overspread about two or three hundred acres of land.

The outer edges appeared to be thin and vapory, while the space below the cloud was filled with a kind of light, waving substance, resembling a morning mist. This was constantly in motion, and as the cloud moved toward us this stringy, root-like mass of mist was whirling and twirling in rows about as wide as the compact surface of the cloud. This singular tube-like formation and motion was what first created in our mind the alarming impression that the dreaded cyclone was approaching us. The phenomenon was more like water running through glass tubes than anything to which we can compare it.

It was truly a beautiful sight; yet, no artist could in safety to his life, stop long to study its beautiful conformation. From the center of this collection of revolving streamers there came a balloon-shaped, green-looking cloud, or rather crooked, smoky column, which extended about one hundred feet in the air—this is the cyclone proper.

It kept constantly changing its position, motion, and shape. At no time did it look the same as at another; sometimes funnel-shaped, larger at the top, then inverted and larger at the bottom. It came wriggling, jumping, whirling, and twisting like a great, green snake, darting out a score of glistening fangs. These antennæ-shaped things were bright and clear, but in a few moments went out of sight behind the enveloping clouds, which were struggling to embrace the cyclone. There had been very little lightning and only a few low rumblings of thunder. Scarcely enough rain fell, from first to last, to lay the dust, and no rain at all during the cyclone. The cyclone was right on us before we noticed any unusual force of wind. The wind had been blowing as much from one point as another. When this cloud had come out clearly to view and transformed itself, as we have related, another cloud, not so large and in no way, save color, like the first, was seen moving from a point far south of west.

The two were approaching with astonishing rapidity. Presently they seemed to be converging, and in a few minutes they met. Before they met the lightning played from the back of one to the other, like fiery serpents. After they met all definite shape was lost. The color of the whole mass was a little darker, and all the clouds and parts of clouds were jumbled up together, and rolling and boiling around in the sky. In a few moments two of the most vivid flashes of lightning I ever beheld descended from mid-sky to the earth. These strokes were about one hundred yards apart, and were simultaneous.

Not until those strokes did the terrible roaring of the cyclone commence. There had been from the first a low rumbling and muttering, but no well-defined roar. This increased for perhaps one and a half minutes, until it was a deafening sound, something like that made by freight trains crossing bridges, only a little sharper. The wind began then to blow very hard and from the west, but nothing very firm was moved until the cyclone had spun and buzzed over the hill to the southwest of the town, and all at once, whirling and bounding, sprang into the midst of the streets.

After it had passed over and through the streets, indeed, before the force of it reached us, and while it was in the midst of the buildings, there was a still darker and greener-colored atmosphere lit up continually by tinges of orange and gleams of red.

Many can testify to the singular appearance of the light emitted from beneath, above, and from within the folds of the cyclone.

Houses and fences were not blown down, it is true; some of them were, but in general they were drawn up and twisted around, and then fell back on their foundations. There was not much evidence of any great force of straight wind; only here and there were objects found pointing the same way. As much *debris* was found thrown in one direction as another.

The path of the cyclone was nearly northeast, and was about two hundred yards wide.

When within one mile of Brownsville it came in a zigzag course, but before that its main course was northeast, and this direction it kept up until it was scattered. The time of its passage over the city was, perhaps, three-quarters of a minute or more. Its velocity in coming from Montrose to Brownsville—a distance of sixty-two miles—was one and eleven-twentieth miles per minute. Brick houses were seen to rise two feet from the ground and then fall back on their stone foundations, scattering the *debris* in all directions.

Houses were found twisted at opposite points, strong fences were drawn down in shape of square and triangles; boards, posts, gates, scantlings, and stringers were found hundreds of yards off, thrown at all possible angles.

Hardware stores, blacksmith shops, plow-rooms, and display houses, were totally demolished, showing no signs of being blown. A safe belonging to George W. Smith was found some forty or fifty feet from where it stood in his office. There were strong currents of attraction toward this cyclone.

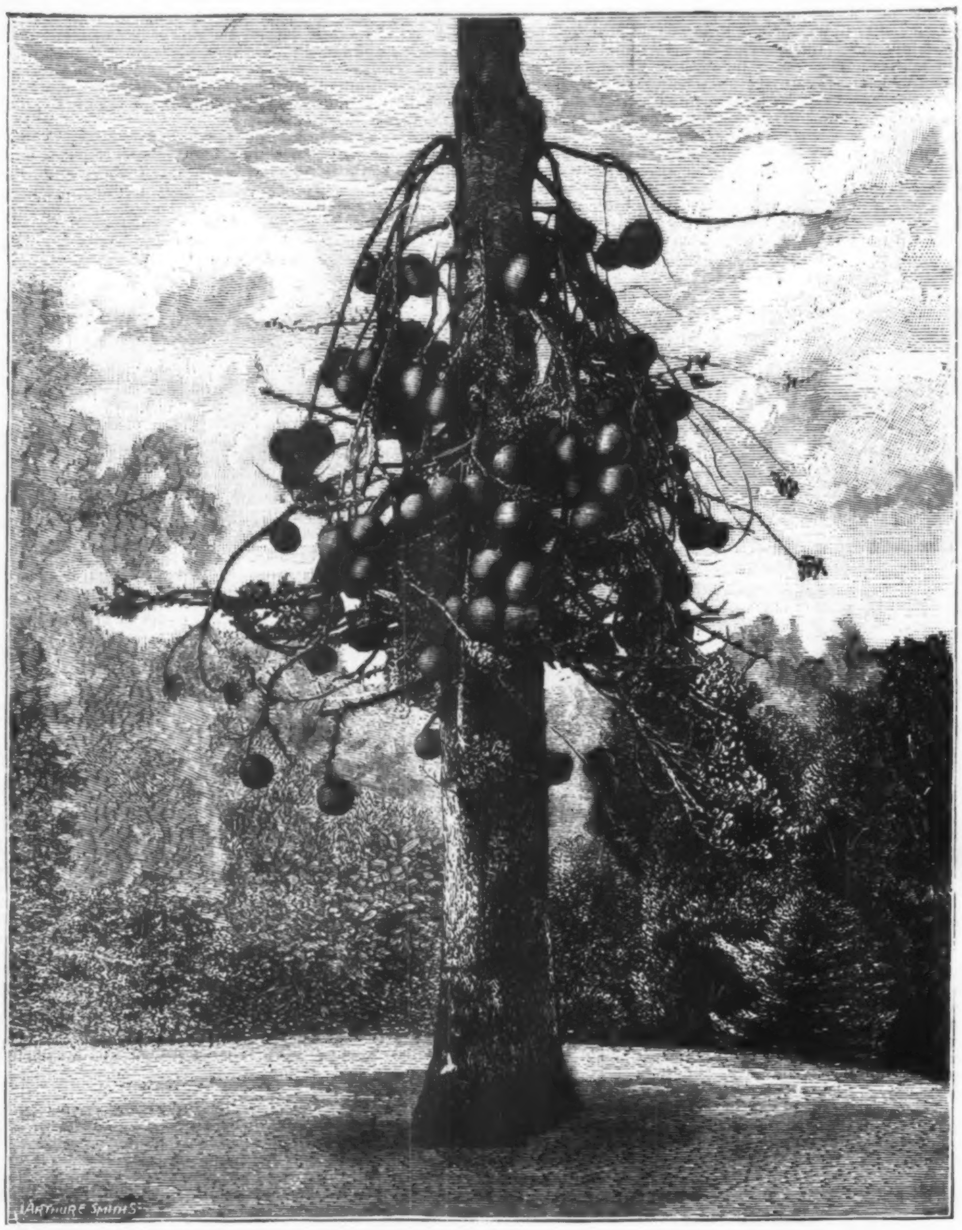
Places were found where trees one and a half feet in diameter were drawn out of the ground, roots and all, while not ten feet away frame shanties remained standing. Scantlings and fence-rails, after whirling around in the air, were thrown off at a tangent and flew like darts through frame buildings, and in some places were found sticking to the depth of two feet in the ground. A flock of geese was

drawn up into the cyclone, whirled around and picked clean of feathers, then scattered in pieces almost everywhere. Plank, grass, shingles, brick bats, dust, feathers, branches of trees, bark, fence-rails, animals, etc., were seen whirling and twisting in the air above the cyclone, as it came down Blackwater and passed over us. In some places large trees were peeled from top to bottom. The cyclone was seen to jump and spin around on the prairies near Brownsville, then rise, whirling and rolling in the air, throwing out those glistening tongues, and coming down again hundreds of yards off.

Wherever it bounded on the ground nothing remained intact. Such are some of the peculiarities of this cyclone. —*Kansas City Review.*

THE CANNON-BALL TREE.

Mr. Jenman, the colonial botanist at British Guiana, sends us a photograph of the flowering and fruiting stem of a young cannon-ball tree, taken in the promenade gardens, Georgetown, British Guiana, which we have had engraved (see Fig.). This particular tree, which, as will be seen, is well named, is about 45 or 50 feet high, with a stem 18 inches thick, free of branches, as shown, and with a handsome spreading, hive shaped head of dense dark green foliage. This is a young tree. In its native forests it grows to a much greater size. *Couroupita guianensis* inhabits the wide-stretching alluvial lands skirting the rivers of British Guiana, where it is plentiful, attaining a height of 80 to 100 feet or more. It is of free growth, and quickly forms a fine feature as a specimen plant in a tropical garden. It suddenly drops its leaves in March, and in a few days is again clothed in fully developed foliage of the richest green. The flowers are large, freely produced, curious in form, pink in color, and highly scented. The solid rusty coated fruits are about 6 inches in diameter, and contain a quantity of flat circular seeds, rather larger than a sixpence, embedded in their pulp. The tree belongs to the Lecythis family, and it is stated that the hard shells of the fruit are used as drinking vessels.—*The Gardener's Chronicle.*



THE CANNON BALL TREE.

THE CALIFORNIA JUNIPER.

The California Juniper differs from the western or eastern species. Quite often it amounts merely to a depressed shrub, or a small tree 20 or 30 feet high, the bark of brown body and shreddy, wood pale, outline of tops irregular, branchlets enormously thick, tiny scale leaves, generally in threes. On young shoots the leaves are loose and oval form, and in age they become short and thick, rounded at the tips with horny fringes on the edges. While resembling the western juniper, the California variety is readily distinguished by its fruit, which is drier, more sweetish, and not so resinous in taste as that of the western juniper. The California species is found in the vicinity of San Francisco, on the Oakland hills, Mount Tamalpais, and Mount Diablo, all along the coast range in general, and in the islands off the coast southward; also in the Sierras and on to Utah and Arizona. The juniper climbs readily to any cliff, and thus forms the most substantial, perfect, and lasting screens, walls, mantels, or mats of verdure over the most arid, sandy, or rocky places. The berries are universally used in spirits. Hitherto there has been scarcely any call on the coast for such superior timber, but it is predicted that when a naval demand for knees or short ships' timbers shall result in the investigation of these forests, no lack of resource can limit the supply.

GARDEN CULTURE OF ROSES.

There never was a time when roses were receiving more attention at the hands of floriculturists than now. In England, France, and this country, both professional and amateur gardeners are devoting themselves to their culture, and whole gardens are given up entirely to roses. Immense numbers of varieties are grown, and each florist vies with his fellows in the production of new varieties which will excel all others before raised. In the United States, Messrs. Ellwanger & Barry, and the Dingee & Conard Company, have made the culture of the rose a specialty, while Peter Henderson and many others have raised them in great quantities. The American Banner, a striped tea rose of great beauty, was raised by Mr. Henderson, and as yet it has had no rival in the beauty of its shadings.

The hybrid perpetual roses, although misnamed, as they are far from being perpetually in bloom, are a most desirable class to cultivate in the garden, because they are so hardy and of such a vigorous growth. They have almost superseded the old-fashioned Provence, Cabbage, York, and Lancaster, Yellow Harrison, Scotch, the single white, Sweet Brier, and double white roses which were so dear to my childhood. Even the early cinnamon roses have a place in my heart.

To grow roses satisfactorily, their habits must be consulted, and the richest of soil prepared for them, so that their roots can strike down deeply and send up strong shoots. In making a bed for them, it should be dry to the depth of two or three feet at least, and the old soil all removed, if it has been exhausted by other plants. Then throw in strawy compost from the stable heap (if unfermented it will not harm the roses at the depth of three feet), pound it down firmly, and add two feet of the richest loam you can procure. Or make a compost of two parts garden soil and one part of one-year-old horse-manure, and a little sand mixed in to make the whole mass friable. Stir up this compost well, and if you can mix in a few shovelfuls of clay, it will not injure the roses, but give strength to their roots. The finest moss roses I ever saw were grown on clayey soil made friable with sand and manure, and their growth was marvelous.

The best time to set out roses is in the autumn after the summer growth has become well hardened. The old growth can be cut back closely, and the roots must be tightly planted. The most vigorous roses can be transplanted with success in October or November, according to the locality. March and April are the best spring months for making rose-beds. A circular or oval bed of roses is the greatest addition to every lawn, and the handsomest beds of delicate monthly roses I ever saw were made in this manner. The roses were kept in pots in a frost-proof cellar during the winter, and in April the beds were prepared for them by digging out the soil to the depth of two feet, and the manure of the previous year was also thrown out, and another quantity added; then the decayed manure was mixed with fresh clayey loam, leaf mould, and sand, well stirred up, and the beds were ready for the roses. As soon as the cold nights of the season were past, forty to fifty monthly roses were put into each bed in circles, and from June to October they were one mass of bloom and sweetness. Many were cut for bouquets, which increased the bloom of the plants much more than if the roses had been allowed to mature and fade away; for the more liberal you are in cutting your roses, the more plentifully will they flower, and this applies also to many other kinds of plants. If you will cut them before they go to seed, others will continually spring up to supply their places.

Moss roses are the belles of the rose garden, but they are chary of their blossoms, which rarely appear but once in a season, although there are varieties which are called "perpetuals," but only give a few flowers upon the second growth in the autumn. There are nearly a dozen varieties, all desirable. They vary in color from a dark purple to the purest white.

Blanche Moreau is the latest novelty among moss roses, and has snowy white flowers covered with deep green moss, and it blooms in large clusters, and is called "perpetual" because it will flower in the autumn if it is richly fed. My moss roses are now in the height of their beauty, and their foliage has been kept free of slugs and rose bugs by sprinkling Dalmatian or Persian insect powder over their leaves when wet with dew. Mad. Plantier, Gen. Jacoueminot, and other favorite hybrid perpetuals, have also been kept unmolested by slugs, by frequent applications of the powder, which, although expensive, is most efficacious for flies, water bugs, ants, slugs, and even rose bugs. A showering of alum water is said to be an excellent antidote to slugs and bugs. Dissolve one pound of alum in two and a half gallons of boiling water, and when cool enough to put the fingers into it, apply it to the bushes. A pailful of hot water, into which to shake them is a good insecticide. Among the new roses of the year in the class of hybrid perpetuals are Anicet Bourgeois. It bears finely cupped roses of the brightest cherry red, and is of a very strong habit. George Moreau is globular in form, and has glossy red petals, foilage full and handsome. Mme. Martel has very large flowers of delicate rose color, vigorous growth. Rosieriste Jacobs is of a velvety red, shaded with dark crimson; a very fine rose. Souvenir de M. Droche is of a carmine color, of fine habit, and has large globular flowers.

The new tea roses are very handsome. Baron Alexandre de Vrints has pink roses, striped with red and white, of vigorous growth, and very double. Francailles de la Princesse Stephane is a remarkably handsome rose, a seedling from Gloire de Dijon. It has flowers of a rich salmon-orange color, medium in size, but of strong growth. Mme. Joseph Schwartz has white flowers, tinged with blush, very handsome. Reine Maria Pia, a seedling from Gloire de Dijon, is deep rose, with a crimson center, a large full flower, and very desirable for pot culture. Madame Chedane Guinoisseau, canary yellow flowers, with buds as lovely as those of Catherine Mermet and Niphetos. The noisette roses are very beautiful for garden culture; are quite hardy, and will flower abundantly from the second growth in the autumn, often sending up clusters of forty to fifty roses on one stalk. The Greville rose produces large clusters of roses of different shades of crimson, pink, and white, and is very beautiful for a pillar or wall rose in the areas of city houses, where, with Baltimore Belle and the Prairie roses, it is often grown to conceal the fences.

The following list of hybrid perpetual roses will make an excellent collection for a small garden: Anna Alexieff, Beauty of Waltham, Boule de Neige, Charles Lefebvre, Coupe d'Hebe, Dr. Andry, Dupuy Jamain, Edward Morren, Gen. Jacqueminot, John Hopper, Jules Margottin, La France, Mabel Morrison, Madame Lacharme, Madame Charles Wood, Baroness de Rothschild, Marie Baumann, and S. Reynolds Hole.—*Daisy Eyebright, in Country Gentleman.*

FISH CURING IN NEW YORK.

To the mind's eye of the imaginative man, the sight of a pile of dried fish suggests pictures on far-away, wind swept, sun-baked beaches, the nodding masts of little rocking smacks at anchor near the shore, sturdy, bronzed fishermen lounging aimlessly, tarry nets spread to the sun, dories of silvery fish, long lines of rough frames on which broad fish, thick piled with salt, are drying and bleaching in the sun, and in and through all, the fresh, invigorating ocean breeze, bearing on its wings the creak of blocks, the flap of cordage, the plash of waves, and sound of cheery voices. But the practical man, who has looked into the subject, sees another picture, devoid of all those picturesque features and associations, in the narrow space of a city building, heavily redolent of fish and wood smoke, where the business of preserving fish for the market is carried on all the year round, upon a scale that would dwarf the operations of an entire fishing village.

There are a dozen firms in New York that carry on the business of drying, pickling, and smoking fish. With a single exception they devote themselves almost wholly to the curing of cod, mackerel, and salmon that are brought here in barrels pickled in brine, furnished to them, according to contract, by the fishermen. The work that they do consists mainly in drying the fish of the brine, and smoking them if desired. The one establishment which is the exception, an old-established house on West Nineteenth street, which has its own fisheries as well as the same sources of supply with the others, does a much more diversified and interesting business. One of the firm said the other day:

"We have fisheries on the Florida and Georgia coast, where we get the sturgeon, which is one of our leading specialties, and also shad, which we smoke. From the roe of the sturgeon we make down there the caviare, which we claim to produce better than the Russian caviare, and for which we took the prize medal at the great fish exposition

in Berlin, in 1880. The eggs of the sturgeon are washed well through successive waters, passed through three sieves, one after another, to facilitate thorough cleansing, and are packed in kegs with a certain proportion of salt. That's about all there is in preparing caviare. The sturgeon fishing is very dangerous work. The men fish for them with drift nets 100 fathoms long and 20 fathoms deep. Such nets are very heavy to handle from small boats. Then the fish themselves are ugly customers, often weighing from 300 to 500 pounds each, and, to complicate matters and make more trouble, big sharks, and sometimes alligators, have a way of getting into our nets, tearing them and smashing boats in a savage way. Not infrequently, if the weather is rough, our men are unable to make a landing for as much as three days at a time, remaining at sea all that while in small boats, and occasionally they are lost. Only a few weeks ago two of our men were lost. Alligators in salt water? Certainly. I have here the skin of one twelve feet long that was taken in one of our sturgeon nets. Just at present smoked sturgeon, which is a delicacy, is very scarce, and when we get in a little stock of it we have to hide it from the general trade, in order to supply special customers who have contracts for it. The sturgeon when caught is cleaned, his backbone cut out, and then his sides are packed in ice and sent to Savannah. There they are freshly packed in ice and shipped here by steamer. Here we cut them in slices, dry and smoke them, employing such heat in the process that the meat is thoroughly cooked and ready for eating. The salting in brine occupies about four hours, the drying about six hours, and then for fourteen hours they are kept in a place so hot that you could hardly bear your hand in it, in a thick smoke made from hickory wood and cedar sawdust. The salting, drying and smoking are about the same for all kinds of fish.

"We have also fisheries in Delaware, whence we get sturgeon and a portion of the great quantity of eels for which we have a demand, although our best and fattest eels come from the mouth of the Shrewsbury River. The process of preparing the smoked eels is not different from that applied to other fish; but, as a preliminary to it, they require a vast amount of scrubbing with broom brushes and washing to get the slime off them and make them thoroughly clean. In addition to smoking them, like those you see there (pointing to a pile of what looked like short and greasy crowbars), we put up a great many eels in jelly, a preparation which has met with great favor in this country, and of which we ship great quantities to Europe. Herring are a great item in our business, especially the 'bradt,' or roasted herring, which, after roasting, we put up in kits, in pickle, ready for consumption. We also smoke smelts, caught on the Massachusetts coast mainly. They are a novelty of our own, introduced only a couple of years ago, and have proven a great success, particularly in Europe, where their peculiar delicate flavor has found eager appreciation. In season we smoke a good many of the lake whitefish, a very fine fish, which is not half as well known or appreciated as it should be. It is fatter, sweeter, and finer in flavor than the mackerel, any way that it is prepared, and is simply exquisite when smoked. One of our best preparations of the mackerel is by smoking him round when fresh—what is known as 'Boston smoked.' Among our novelties are lamprey eels, or 'neunangen,' which we import; 'bücklinge,' or young herrings, which we get from the coast of Newfoundland, and geese-breasts, which we get from farmers in all directions and smoke.

"All the fish that we smoke come to us fresh, in ice, except the salmon, which, during a portion of the year, we get pickled. In June we smoke the salmon Nova Scotia style, fresh, and such a delicacy is it deemed that it commands from 50 cents to $1 per pound. Taken altogether we preserve about 15,000 pounds of fish per week, the year through, although in some weeks the amount runs up to as high as 40,000 pounds. An interesting feature of our business has been the favor with which our goods are received in Europe. Whether it is that our American fish are better in themselves, or that our methods of preparation are superior to those employed on the other side, I cannot say, but the fact is that European producers have not been able to compete with us in anything to which the advent of our goods in their market has invited their attention. This business is as yet only in its infancy, and the rapidity with which it is growing, both by foreign and home demand, shows that it will soon become a leading industry in this country."—*N. Y. Sun.*

BEER AND CIVILIZATION.

By Dr. Hans Vogel.

"There are three kinds of thirst," says the witty Brillat-Savarin, "the quiet, the ardent, and the artificial. The first, which is the *quiet* or *ordinary* thirst, is that imperceptible desire to restore an equilibrium, since every breath we draw carries away a certain quantity of moisture. This thirst does not cause any pain, but invites us to drink while eating, and makes it possible for us to drink at any time of day. This thirst accompanies us everywhere, and is to a certain extent an essential part of our existence. *Ardent* thirst arises from an increased need of moisture whenever it is impossible to satisfy the quiet thirst. It is called ardent, or burning, because it is accompanied by a dryness of the tongue and throat, and a consuming heat of the whole body. The *artificial* thirst, which is confined to the human species, arises from that inborn instinct which incites us to seek in our drinks for a strength not naturally there, and which can only be produced by fermentation. This thirst is an artificial enjoyment rather than a natural requirement. It is really an insatiable thirst, because the beverages that we swallow to satisfy it always create it anew. It is this thirst which finally makes the toper. One thing is remarkable, that whoever slakes his thirst with pure water, which seems to be the natural antidote to thirst, never drinks a swallow too much."*

This is another sign of the insatiable nature of man that in no epoch of civilization has he been satisfied to slake his thirst with the means that nature provides for him in cooling water and nutritious milk. We find no race of people, however far removed from the influence of European civilization, that has not discovered one or more products of their native land which are suited to the preparation of fermented drinks with which to stimulate the nervous system and bring before their fancy more rosy-hued pictures than the naked reality furnishes. We must certainly consider those people especially favored by nature who needed only to observe that the sugar of grape juice, or of sweet fruits, could be converted by fermentation into alcohol in order to discover spirituous liquors. The case was quite different where there was a lack of such fruits, and man had to exercise his utmost ingenuity to discover a sugar from the fermentation of which an alcoholic drink could be prepared. To make it clearer, I would contrast beer and wine.

* Brillat Savarin never saw how Americans drink ice-water on a hot day, or else he does not include ice-water under the title of pure water.—Ed.

WHAT IS WINE?

The fermented juice of the grape. The definition is complete, and this applies to the wine of our great ancestor, Noah, "when he came out of the ark," to the wine of which Horace sang, and to the wine—if it is genuine—that we enjoy. But

WHAT IS BEER?

A drink made of malt and hops, some one will tell me. But where does nature furnish man with ready-made malt? All our readers know that no natural substance is understood under this term; it is an artificial product made by the hand of man from barley or wheat. These grains contain *no sugar*, the sugar must first be prepared by the germination of the barley, and made by the mashing. Not until the sweet beer-wort has had yeast added to it and been left to ferment, do the same chemico-physiological changes begin to take place in the manufacture of beer that do in wine making. It is well that we do not know who made the first drop of wine, nor who brewed the first beer, for there might be a fight over the question as to which deserved the most credit and highest honor. For my own part, I should esteem it a much higher honor to have discovered the far more ingenious and difficult process of beer making. It must here be remarked that the definition of beer just given is tolerably worthless for historical purposes, for before the migration of the eastern tribes, hops, which are an essential constituent of modern beer, were not used at all by us Germans.

WHO FIRST MADE BEER?

If I pass next to the question of what country the knowledge of beer making came from, we must give up the old idea that beers are a specifically northern drink, on the ground of the interesting researches of Planitz, whose views I shall essentially follow. That ancient Greek historian, Diodorus, mentions beer as an Egyptian invention. Of course, those who adhere to its northern origin under all circumstances pay no attention to his statement, while the other party repeat his assertion without criticisms as an accepted dogma.

Habich follows Diodorus in the first scientific text-book of beer-brewing, which he published in 1864, and in which he writes as follows: "Osiris, King of Egypt, brewed barley beer in the year 2000 B.C., because the wine made there was insufficient to slake the thirst." Osiris was not a king, but a god of the Egyptian triad, and hence the above remark is open to suspicion, especially in regard to the date. Nevertheless this statement found general credence, except that somebody, I don't know who, substituted the year 1960 for the indefinite date 2000. So that this error is perpetuated up to the present time in all the best text-books on brewing in these words: "According to Diodorus, Osiris, King of Egypt, introduced into his country in 1960 B.C., beer made of malted barley." The celebrated Pasteur, in a contribution to the *Revue des deux Mondes*, asserts this more definitely in these words: "Osiris taught his people the secret of brewing beer."

At the present day we can obtain an incomparably more favorable point of view for judging of this myth of King Osiris by taking into consideration the results of recent Egyptology. We have every reason for pronouncing this Osiris saga, so far as it relates to the *invention* of beer, a Grecian bacchanalian saga, which, under Hellenic influence, was engrafted on the Egyptian body at a later date. It is quite otherwise with what the Greeks tell us about Egyptian beer. We can put all the more confidence in this statement because we find it fully confirmed by Egyptology.

Herodotus tells us, without however mentioning the discoverer, that the Egyptians drink wine made from barley, "because they have no grape vines in their country." Diodorus, whom we know of already, adds that the drink is called *zythos*, a name that corresponds perfectly to the Egyptian word *zehd*.

We have, however, far more important proof in a document of Egyptian origin, one of the so called scribes' letters which were found in an Egyptian grave, and translated and published by Prof. Lauth, of Munich, a few years ago. In one of these the scribe, Amenemau, wrote to his pupil, Pentaur, a fatherly admonition, in which he says: "I am told that you neglect your studies, you yearn for pleasures, and go about from one drinking place to another. Whoever smells of *beer* is repulsive to all, the smell of beer keeps people at a distance, it hardens your soul, etc."

EGYPTIAN BEER WITHOUT HOPS.

Hops were not known to the inhabitants of the land of the Pharaohs, but they put spicy substances in their beer. The hieroglyphics plainly say that barley was used, and the contrasting of white with red barley shows that it was malted; its intoxicating properties prove that it must have been fermented. Beer is proven historically then to have been made first in Egypt, although the name of the discoverer is not known.

NO BEER IN GREECE AND ROME.

Turning next to Greece, we find several terms which philologues have translated by beer, but this is no proof that beer was used by this people who were so rich in wine. The comparative history of civilization has rather proved that the Greeks had no beer, and that whenever a Grecian writer wanted to designate this drink by a Grecian name he had to use a circumlocution such as "wine of barley," or the like. The words *zythos*, and *kyrma*, are of Egyptian origin, while the terms bryton and pinos come from Thrace. In short, these expressions were all foreign terms in Greece.

Among the Romans, a more practical minded people, where the first statesmen did not hesitate to put hand to the plow, we might rather expect to find that they would know how to make beer, but on the contrary we find only the enthusiastic and exclusive praise of wine on the part of the thirsty poets. Even in the time of the later emperors we still find expressions of utter contempt for our beverage. The emperor Julianus Apostata, who first became acquainted with beer in his expeditions to Gaul (France), expressed an unfavorable opinion of it. We may offer the same objections to the Latin names for beer as against the Grecian.

The Romans had names for foreign beverages, but the old idea that they got beer from the Greeks must be dismissed to the realms of fable.

In Spain, beer seems to have been known in ancient times, when it was called *celia*. Orosius derives the name from *calefacere*, because the Spanish warmed the grain, *i. e.*, malted it. In the neighboring Gaul beer was long known, and Pliny tells us that it was called *zythum* in Egypt, *celia* or *ceria* in Spain, and *cerevisia* in Gaul and other provinces. The etymology of the word has been studied and speculated about so much that we need only say that up to the present day it has received no satisfactory explanation.

GERMAN BEER.

Cæsar tells us that the Germans, as well as the Gauls, prohibited, once for all, the introduction of wine into their country. In the time of Tacitus, at all events, the use of beer was very general there, and even then it was the weak side of the German. "Their food is very plain; wild fruits, fresh game, or sour milk; they are content to satisfy their hunger without extravagance and without dainties. Their moderation is not so great with regard to thirst; if any one would take advantage of the German's weakness and get him to drink to his heart's content, he could conquer him as easily through his own vices as by force of arms."

The role which Planitz assigns to beer in northern civilization is in complete accord with this statement. The vault of heaven is the brewing kettle of the gods. In Walhalla, beer is drunk on Odin's table. It is worth mentioning that in those times it was the women who practiced the art of brewing.

Many a philologue has already racked his brains over the German word *bier*, in doubtful attempts to derive it from the latin *bibere* (to drink), but at present it seems to be tolerably well established that it comes from the old Saxon beor, beer.

BEER WITH HOPS.

In regard to the use of hops, which we could scarcely dispense with as an essential constituent of the "stuff" of the present day, I have already said that none were in use in Germany previous to the time of the invasions. We find in Grässe the interesting remark that decoctions of oak bark, ash leaves, and the like were used by the ancient Germans to flavor their beer. The earliest reports that we have concerning hops come from Isidor, of Sevilla, who says that hops were put in beer in the seventh century in Italy. Schwarzkopf challenges this statement, and I myself, in fact, have found no mention of hops where Isidor speaks of beer. But Pippin's letter from A. D. 768, is historically accepted, in which he speaks of *Humlonariæ*, *i. e.*, hop gardens. From that time on we find them more and more frequently in documents, we find them too in the ruins of old cities—hops were cultivated in Germany in the Middle Ages. Their earliest use, however, in the manufacture of beer must have taken place, according to the most recent researches of Cech, in Slavic countries. Its introduction into Germany may well be related to the second invasion.

HOPS IN ENGLAND.

Hops met with a singular fate on their first introduction into England. The first mention of them in that country is in the fifteenth century, but they were very remarkably forbidden there after the City of London had asked parliament to abolish two *devilish abuses*, namely, stone coal from Newcastle and hops, "inasmuch as the latter destroys the taste and is dangerous to the people." Their use was afterward permitted, and in the sixteenth century again prohibited, so that it was not until the beginning of the eighteenth century that they could be legally employed. We may perhaps laugh sympathetically at such shortsightedness of the sons of Albion—and yet!—what would we say if we were still flavoring our beer with oak bark, after the manner of our ancestors, and some one should conceive the idea of putting hops in it because it imparted to it a better flavor and made it keep better, and should openly recommend the addition of hops? I should like to see the stake to which the unlucky bird would be nailed whose love of gain did not hesitate thus to poison his fellow-men. Hops contain, according to the recent investigations of Griessmayer, an alkaloid, a poisonous substance!

BEER IN TIME OF CHARLEMAGNE.

To return to the history of beer itself after this digression, we take up the thread of history with Charlemagne. Under him, beer brewing had risen to a flourishing state, not among the people only but also on the crown-lands and in the emperor's own domains. Under his immediate successors the convents began to take up the manufacture of beer, being aided by the favors of princes. But the masters of the convents knew how to prepare an excellent drink, as well out of Christian charity as because they knew how to prize a cool mug themselves, so that their convent beer, nuns' beer, etc., were always in request as well as their hospitality was noted. "Even at the present day the names of Augustine, Benedictine, and Franciscan beer, are mentioned by connoisseurs with reverence, even though in most places the swearing brewer's boy has long since wrung the mash-stick out of the hands of the pious monks and driven him out of the place.

Henry I., of Saxony, is an important figure in the history of civilization. Up to his times, the Germans, true to old traditions, had lived on scattered farms, and when brought together into towns at first every one brewed in his own house, but in time this state of things naturally yielded, for practical reasons, to public brewing by the municipality. The shrewd fathers of the city sought, as far as possible, to make beer-brewing a very profitable monopoly of the State, and it was very hard for a citizen to defend his inherited right of brewing beer against the magistrates. The latter did not brew themselves, but kept their brew-boys and bottle-boys, with a master brewer over them. Coexistent with this, there existed the "beer mile," which gave the city the privilege of selling in all places within a mile,* free from all outside competition. Many cases are recorded where beer from another place has been seized and poured out on the public highway. The founding of "Rathskellers," many of which afterward became famous, was associated with this law respecting the rights of cities.

A new disarrangement of the existing relations resulted from the increasing power of the *guilds*, which augmented their own reputation by strictly excluding all improper persons, and furthered industrial interests by joint advice and counsel. Suitable regulations for brewing were issued and the methods described, with cautions against adulterations. For the benefit of those who are always sighing for the "good old times" with its beer, we can say that owing to the complaints of gross adulterations in beer decrees were issued against it in 1155 at Augsburg, at Munich in 1420, and at Paris in 1264.

ANCIENT TESTS FOR BEER.

Barley was considered the *best* material for beer, but in bad times oats were used—in times of poor harvests frequently no beer at all was brewed. The *bierkieser* (beer-tester) had to decide whether the beer was fit to sell. Beside the taste he relied chiefly on the "leathern breeches

* The German mile is nearly equal to five English miles.

test." Some beer was poured on a bench and Mr. beer-tester sat down in it with his leather breeches on while he tried the flavor of a considerable quantity of beer. When the honorable father of the city arose, if the beer was made of good stuff, the bench remained hanging to the seat of his breeches and arose with him of course.

The brewers' guild honored as their patron saint, Gambrinus, a fabulous King of Flanders and Brabant. He is supposed to have been originally designated as Jan. 1 (Jan. primus), which passed into Gambrinus.

The first flourishing period of Gambrinus's kingdom is long since past; it coincides with the age of the renaissance, the rise of which is itself intimately connected with the general vigor of that epoch. Accurate observations of the phenomena of fermentation had led to an important advance in brewing beer; they had learned to brew lager beer, so that a supply of the stuff would be made in winter for the warm season.

"Not merely in rathskellers and in village beer-saloons," says Planitz, "did the peasant and the townsman swig his fill; not only at the high schools did the students run with lunch and sword to the *kneip*, studying and fencing behind their tin mugs; but in the banquet halls of princes and in the boudoirs of noble ladies, the juice of the barley was a highly prized refreshment, which was not sipped stealthily from tiny wine glasses, but partaken of with self-consciousness and ease." I must subsequently speak of its excessive use, and will here merely mention one of the rules of the beer cellar of Prince Ernst, of Saxony, celebrated for his economy, in which he allows the countesses and other noble ladies four quarts of beer, and evenings but three. This was in 1648.

In those times which were dizzy with beer, we have many descriptions of the different kinds of beer, their manufacture, their effects, etc. It must "unfortunately" be said that they arose to poetical utterances in praises of their beer.

"With such emulation among literary men, it will be easily explained that even the dignified representatives of science did not refresh themselves with barley juice in theory only, but that many a little mug and jug disappeared behind their stiff neck-cloths. The student world of that day—be they disciples of law, theology, or medicine—strove earnestly to follow the example set before them by their learned professors, whence it may have happened that the youth of to-day so gladly wheel into the invitingly open doorway of the cool beer cellar."

The fact is not to be overlooked that in South Germany, where beer now occupies so prominent a position among beverages, its production had not reached as high a stage of development as in North Germany. Saxony, Mark, and Pommerania, were designated as the greatest drinking countries, but each of these North German beers had a special name; I may mention the Braunschweig Mumme beer, and the Eimbecker beer, that Luther loved so well. As commercial intercourse has expanded in our times these beers are sent to the most remote parts of Germany and even beyond its borders.

If I were to compare that first flourishing period of beer, with its second one of the present day, we should notice that although the individual consumption of beer in the renaissance was large, and almost immoderate, its manufacture was only possible on a small scale, and was distributed among many persons. At the present time, in the second period of its splendor, we see its manufacture aided by machinery of every sort and its production vastly increased, but passing more and more into a few hands. On the other hand the quantity drunk by each individual has decreased, although on the whole a great deal more is manufactured. This much is certain, that, excepting a few academical beer sponges and other such "casks," the individual power of annihilating beer among our fellow-men of to-day does not approach the beer-guzzling of the renaissance. What is remarkable and sufficiently characteristic of the exchange of places between cause and effect in the history of civilization is that, while in the first epoch beer succumbed to the competition of distilled liquors, in our times beer is used as a means for stopping and holding in check the injurious use of gin. During its former reign, beer was used to such an extent than in many sections its use became a vice against which war was waged—in vain unfortunately—by laws and ordinances. Such edicts against drunkenness existed as early as the seventh century. Thus in A. D. 810, the elderly divines were advised to set a good example to the younger ones, and to abstain from drinking, after having been reminded in 802 that the love of drink was the home and the nurse of all vices, hence transgressors were threatened with excommunication and even with corporal punishment.

Intemperance was at its highest state at the beginning of the sixteenth century, not merely in the lower strata of society but with the higher classes of the people as well. Wars and famines seemed only to increase the desire for stupefying draughts. In 1495 a command was issued that the people should refrain from "toasting to full ones, halves, or equals." In 1524 the electors and bishops formed themselves into a "moderation society." The previous year a pamphlet appeared in Bamberg: "On treating; new vices and abuses, the result of disgraceful and shameful toasting and treating, with which all Germany is now soiled and stained." The storm against the threatening evil blew in verse as well as prose, but it helped not, nor did G. Frank's "Book of the Horrible Vices of Drinking," and Fredrick's instructions against the devil of drink.

It must be mentioned that at this time the Munich Court Brewery was already in existence, because here the fame of Munich beer was born, raised, and was kept from languishing through the age of perukes and cues, after the monasteries, which had contributed so much to the renown of Munich beer, had been closed.

DECLINE OF THE FIRST PERIOD.

I must now return to the general consideration of the decline of its first period of prosperity, wherein I shall follow the masterly characteristics of the time as given by Planitz.

Under Louis XIV. France learned to ingratiate herself into the political relations of every country, and the whole public and private life was soon subject to the influences of French culture. They conversed in French, they prayed and swore in French, their amusements and sins were French, they ate and drank in French—every effort of these sad times was to ape everything that the young cavaliers had learned in Paris; sad times were they for the patriots, sad for beer brewers and for beer—*quelle horrible parole*—beer was *une boisson du commun*. The splendid mugs and tumblers were banished to the rubbish room, champagne glasses from Paris and china cups from Dresden took their place. Formerly the count and baron sat at tables of carved oak and held the mug with firm fist—now the dapper little pages in their buckled shoes trip over the parquette and offer their confections and fragrant tea. How brilliantly the beer-drinking tobacco club at the court of Berlin broke up. The Gustavus-Adolphus boots were drawn off, the coarse cocked hat and feather were laid aside or both exchanged for silk stockings and foreign wigs.

The whole kitchen was turned upside down. Parisian cooks, with their foam-spoons and tart knives, took the place of the housewife now rustling through the parlors. Nervous stimulants and *warm* drinks are now on the table. While formerly coffee and milk, or beer, were partaken of in the morning, coffee breakfasts and schnapps now find admission. And what is very remarkable, these new innovations from outside were accepted by the usually conservative citizens with overwhelming haste. In the middle ages of the early renaissance warm drinks were unknown, or at most a little warm wine was taken occasionally for medicinal purposes. Now everything was turned wrong side out; these affected men in cues shook their heads at a drink of which their grandsires had drunk a four quart can. Only the lower strata of the people, the peasantry, and a few isolated places, like Munich and the monasteries, opposed these foreign ways. But a change of character followed, and South Germany began to prepare for the move that would mark an epoch in her history by taking the lead in beer. Even in the last half of the eighteenth century it was customary to speak of the Bavarian and Bohemian methods of brewing, when such things were mentioned at all, as the best.

THE REVIVAL.

The first signs of revival of beer making were noticed in the time of Napoleon I. Certain important discoveries lead to it, such as that of the saccharometer for example, and seemed to awake the interest of theoretical and practical men, only to have it destroyed again by the wars of Napoleon. "Finally the police deserve the credit of raising up again the trampled germ. Adulterations and deceptions, then more flourishing than now, rendered it advisable to seek for ways and means of being always on their heels. The exchequer became more and more convinced that the juice of the barley was as beneficial to humanity as to the empty money-bags of the state, and hence it came about that the slumbering interest of manufacturers and investigators was again directed to beer by the state." At that time new methods of analyzing beer were discovered by such men as Gay-Lussac, and afterwards by Fuchs and Steinheil, who leveled the ground on which Balling, in 1850, accomplished so much that was conducive to the science of beer. But in order to judge of it intelligently the men of the theory were compelled to study the process of brewing in the steaming brew-houses, and this gave theory and practice a chance to come nearer together.

LAGER BEER.

About this time, it was at the close of the year 1830, that three young men came together and started westward to gain a knowledge of the art and science of brewing beyond the German borders, namely in England: Dreher of Vienna, Meindl of Braunau, Sedlmayr of Munich. Meindl was recalled home on his way there; the other two spent several months in the city on the Thames, and diligently studied the English process of brewing. Sedlmayr brought back with him the saccharometer, which was then unknown in Bavaria, and enlarged his brewery so as gradually to prepare for its subsequent great extension, which took place when he called in the aid of steam. All Germany was then, like its smaller cities are now, overflowed with corner breweries. It was an unheard-of thing to boil a thousand buckets full at once. Sedlmayr soon found an active successor in Munich, and this city, with its carefully guarded slow or bottom fermentation, represents the modern flight of beer brewing, although it is worthy of note that other Bavarian cities lead in exports, namely Erlangen and Culmbach.

Bavaria had already attained to the summit of its zymotechnical development, when suddenly, at the beginning of the year 1850, a new species of beer appeared, viz., Vienna beer. The chief distinction consisted in the fact that in Bavaria a much darker and more highly kiln-dried malt is used, which imparts a totally different character to the beer.

VIENNA BEER.

Anthon Dreher, the traveling companion of Sedlmayr, on his return, began to reorganize the brewery at Schwechat. By adopting the English method of malting and the Bavarian process of brewing, he laid the foundation of his subsequent gigantic success. The first year he boiled 6,000 buckets full at once, and, contrary to his own expectation, sold it all on draught. But he was not satisfied with his conquest of the Austrian capital, but sought to establish Vienna beer as a worthy rival to Bavarian beer by a colossal export to all parts of the world. He left to his son the largest brewery in the world. In his present establishment 3,800 buckets can be boiled daily. His cellar holds 363,000 buckets. The man who was delighted at having boiled 6,000 buckets in the first year, as a rarity, produced 680,000 buckets in one year forty years later.

PILSEN BEER.

I must now briefly mention the third variety of beer, related to Vienna beer, and having its center at Pilsen in Bohemia. It is lighter in color and strength than Vienna beer, but contains more hops.

In north Germany the revival of the industry did not reach its highest development until a comparatively later date. The beer made there is more like the light beers of Austria.

One of the chief factors in this rapid development of the second brilliant epoch is to be found in the facilities afforded by railroads and steamboats for rapid transportation throughout the world. The mechanical arrangements for its production have also received unexpected improvements. Cheap power of steam saves the costly manual labor in a great number of manipulations—a blessing, on the whole, to mankind, although no advantage to the small brewers, who are continually more and more oppressed by the competition of large brewers, even in country places. In Munich this struggle for existence with the corner breweries, that were formerly so numerous, has long since been decided, and no one there will express an earnest desire for a return to the old times.

With the technical progress of beer brewing that we have sketched went hand in hand the chemistry of beer—a proof of which we have in the brewers' schools, many of which are already exerting an important influence. I need only mention the one at Weihenstephan near Freising, under the excellent management of Dr. Lintner, to whom students are flocking from foreign parts as well. No matter how much one portion of the beer-drinkers may inveigh against "chemistry in the brewery" it is an incontestable fact, in spite of all this hue and cry, that the beer of our times is better than that of the past, and in this progress the science of chemistry has had a fair share. But chemistry has not yet reached its highest perfection, and we must not imagine that the art of brewing has completed its development.

If chemistry is reproached with having aided adulterations this does not affect the science itself, any more than the discovery of nitroglycerine is to be blamed because a Thomas or other outcast of society has made use of it for nefarious purposes.

I have already mentioned the fact that in our day beer has an important part to perform in reducing the injurious consumption of strong liquors. That is indeed enough!

I have also noticed the fact that beer, so far as poetic effusions are concerned, has played a very modest part in the history of lyric literature as compared with wine. Permit me, dear reader, to close with the best sentiment that I have been able to find in this direction, the verse that is over the entrance to the Tivoli Brewery:

"Geniesst in edlen Gerstensaft
Des Weines Geist, des Brotes Kraft!"

—*Humboldt, August*, 1882.

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